

# **energywise**

(also known as Vulnerable Customers and Energy Efficiency)

## **The Final Energy Saving Trial Report**



[ukpowernetworks.co.uk](http://ukpowernetworks.co.uk)

"It's a very good project, it's very useful. You can manage your budgets much better. The meter helps me to know where I'm at."

"I'm on a pay as you go meter – it's great to see on the energy display how much energy I'm using, and when I need to top up."

"I just think you've got a lovely team that work well together; individually if I have any questions they are always explained really well; you have a majority of mixed ethnicities in your team which is good."

"Everything has run smoothly. I think the new meters are good. I've heard the scare stories, but I wouldn't want to change it."

"I'm using the standby saver on my TV, with the Sky set and consoles. The kids moaned a bit that they have to wait a bit in the morning for everything to come on, but I told them that we were wasting lots of money having it on all night, and they've got used to it now."

"**energywise** has really come at the right time, it's a good thing, it's a helping hand, it's like a bonus thing, we're really pleased about it. We're going to carry on budgeting, it's really helpful"

"I've been going to the panel meetings; they cover a lot. Whatever has been raised in the meeting they seem to act on it, so I find that really useful. They do take notice, and I'm really happy with that."

"The people who came and knocked on my door were very nice; I don't usually like it when people come to her door, but they were very nice and it didn't take too much for them to persuade me to sign up."

"I wasn't sure of the offer when I read the letter, and had never heard of **energywise**, but an amazing lady came and explained in detail the process and that it would fit around my schedule. I'd never go back."

*In this page: quotes from **energywise** participants on their experience within the project so far.*

This report is the final report of Trial 1 addressing a full year of monitoring data from the **energywise** energy saving trial. It revisits the SDRC 9.3 report submitted to Ofgem on 30 June 2016 and provides a 12-month update of the energy saving analysis and network modelling as well as an up-to-date view on customer protection. The June 2016 report addressed the Successful Delivery Reward Criteria 9.3 "Energy Saving: Impact of energy saving trial interventions – level of fuel poor participation and network impacts" set out for the Vulnerable Customers and Energy Efficiency project, also known as **energywise**, in its licence direction:

[https://www.ofgem.gov.uk/sites/default/files/docs/2014/01/vcee\\_project\\_direction.pdf](https://www.ofgem.gov.uk/sites/default/files/docs/2014/01/vcee_project_direction.pdf)

## Contents

1	Executive Summary	1
2	Introduction	4
2.1	The Project	4
2.2	Project Partnership	5
2.3	Project overview	6
2.4	Project aims and objectives	7
2.5	How is the project breaking new ground?	8
3	Trial participants	10
3.1	Selection and recruitment of trial participants	10
3.2	EPC rating	13
3.3	Home Energy Survey	13
3.4	Energy Social Capital in the trial area	19
4	Trial 1	28
4.1	Trial 1 overview	28
4.2	Trial 1 interventions	29
5	Customer insights	33
5.1	Electricity data	33
5.2	Quantitative analysis	35
5.3	Trial 1 control group contamination effects	42
5.4	Statistical generalisation	44
5.5	Qualitative insights	45
6	Network insights	51
6.1	Half-hourly network modelling	51
6.2	Half-hourly household load profile trial data	54
6.3	Half-hourly network load profile data	60
7	Comparison against technical potential	68
7.1	Technical potential trial impacts	68
7.2	Energy saving impacts observed in Trial 1	69
8	Insights on customer protection	72
8.1	Introduction to customer protection strategy	72
8.2	Customer panel insights	76
8.3	Insights from participant interviews	79
8.4	Temperature monitoring	79
8.5	Compliance to Communication Plan and Data Privacy Strategy	85

9	Learning outcomes	88
9.1	Learning Outcomes: Selection of Participants	88
9.2	Learning Outcomes: Customer Recruitment	89
9.3	Learning Outcomes: Customer Protection	90
9.4	Learning Outcomes: Drop-outs and Ongoing Engagement	91
9.5	Learning Outcomes: Installation Process	93
9.6	Learning Outcomes: MDU Installations	94
9.7	Learning Outcomes: Equipment	96
9.8	Learning Outcomes: Research Aspect	98
10	Conclusion	101
11	References	104
	Appendix A: External Control Group	105

## Glossary

Term	Description
<b>CLNR</b>	Customer-Led Network Revolution
<b>Control Group</b>	The group that does not receive the interventions in Trial 1, and is used for comparison to the intervention group to see if the interventions had any effect.
<b>Customer Field Officer (CFO)</b>	The intermediary hired by the project to be the contact for participants, and the ‘face’ of the project. The Field Officers duties will include recruiting and engaging participants along with gathering data.
<b>Data logger</b>	A non-fiscal meter that measures electricity consumption. It also referred to as secondary electricity meter.
<b>DID</b>	Difference in difference (methodology)
<b>DNO</b>	Distribution Network Operator, responsible for managing one or more of the fourteen electricity distribution networks in Great Britain, delivering electricity to customers.
<b>DSR</b>	Demand Side Response
<b>EAC</b>	Estimated Annual Consumption
<b>EELG</b>	Element Energy Load Growth (model)
<b>Energy Social Capital (ESC)</b>	Context-specific social capital: purposively seeking information from people known to the respondent on the topic of energy efficiency in a home.
<b>External Control Group</b>	A group that does not receive an intervention as part of the project, but has had a smart meter installed previously. The external control group will enable generalisations to the wider population and enable understanding of influence of external factors on energy consumption, for example fuel price changes.
<b>HAN</b>	Home Area Network.
<b>HES</b>	Home Energy Survey
<b>IHD</b>	In-home display. Refer to “Smart Energy Display (SED)”
<b>Intervention Group</b>	This is the group exposed to the treatments (interventions) in Trial 1.
<b>IQR</b>	Inter Quartile Range. A range used for Turkey’s method for handling outliers in a dataset.
<b>LCL</b>	Low Carbon London
<b>LCNF</b>	Low Carbon Networks Fund, administered by Ofgem. Designed to support projects sponsored by DNOs to try out new technology, operating and commercial arrangements. The aim of the projects is to help all DNOs understand how they can provide security of supply at value for money as Britain moves to a low carbon economy
<b>LED</b>	Light-emitting Diode
<b>Loop monitor</b>	The electricity monitoring equipment installed in prepayment control group households. It consists of a clamp connected to the standard meter tracking the electricity consumption. It is configured to return half-hourly readings intervals.
<b>LPN</b>	London Power Networks



<b>MDU</b>	Multiple Dwelling Unit meaning a building housing more than one premises with physical disparate metering such that a wireless MDU Communication Infrastructure is required.
<b>MDU Communication Infrastructure</b>	The wireless communication infrastructure that will be tested, installed and commissioned in certain categories of buildings.
<b>Pilot study</b>	A small scale preliminary study that usually takes place before full investigation in order to test certain elements of the main study e.g. a research design.
<b>QA</b>	Quality Assurance
<b>Smart Energy Display (SED)</b>	The display unit that accompanies the Smart Meter that displays the energy consumption and cost of energy unit. It is also known as In Home Display (IHD)
<b>Smart Energy Expert</b>	The appropriately trained engineer of British Gas tasked to install smart meters according to the Smart Meter Installation Code of Practise (SMICoP) and internal British Gas processes.
<b>Smart Meter</b>	The advanced meter offered by British Gas as part of their business as usual activities offering advanced functionality compared to a traditional meter.
<b>Time of use (ToU) tariff</b>	An electricity tariff that varies the cost of fuel at different times of day or week, with the aim to encourage households to move electricity consumption away from peak periods.
<b>VCEE</b>	Vulnerable Customers and Energy Efficiency

## 1 Executive Summary

In December 2013, UK Power Networks was awarded £3.3 million of funding from Ofgem's Low Carbon Network Fund (LCN Fund) for the Vulnerable Customers and Energy Efficiency (VCEE) Tier 2 project also known as **energywise**. The **energywise** project investigates how DNOs, in collaboration with an energy supplier, charity groups and local community actors, can support residential customers who may be struggling with fuel bills to better manage their household energy usage and consequently their energy bills by changing their behaviour.

Help to fuel poor and vulnerable customers through schemes such as the Energy Company Obligation has historically relied on interventions with laboratory or field measured energy savings. The benefits of installing, for example, cavity wall insulation or loft insulation have been measured in laboratories and tabulated<sup>1</sup>. In that sense, one of the purposes of the project has been to try to put energy efficiency initiatives such as **energywise** on a similar footing, so that government and other interested parties are better informed in this area.

However, to date there has been limited evidence on the benefits that can be achieved by fuel poor customers when provided with smart metering solutions, time of use (ToU) tariffs and other energy saving measures. The overarching aim of the project is therefore to monitor and measure the impact of such interventions, in order to enhance insights into the needs of fuel poor customers and to explore the means of engaging with them to facilitate increased participation in energy saving and Demand Side Response (DSR) campaigns. In this context, the project will demonstrate the extent to which this group can be engaged in such activities and, consequently, whether changes in their energy consumption away from peak demand periods can benefit the network by deferring or avoiding network reinforcement.

Following the successful recruitment campaign run in Tower Hamlets and the installation of smart meters and monitoring equipment in all participants' households, in 2015 the project commenced the first trial, which aims to identify any change in the household energy management behaviour, and the impact on the electricity network, that can be realised through energy saving measures.

The report addressing the third Successful Delivery Reward Criteria (SDRC 9.3: Energy Saving) was submitted on 30 June 2016 and is focused on the results from the first six months of the energy saving trial (defined as August 2015 to January 2016) and on the insights regarding customer protection gathered by the project at that time. This report is the final Trial 1 report addressing a full year of monitoring data from the **energywise** energy saving trial that was completed on 14 February 2017. It revisits the SDRC 9.3 report submitted in June 2016, providing the latest results from the 12-month energy saving analysis and network modelling as well as an up-to-date view on customer protection.

This report is intended for:

- Policy makers and consumer groups interested in the results from the energy saving trial;
- Policy makers, energy suppliers and distribution network operators (DNOs) looking to understand the issues around rolling out smart meters to this part of the community;
- Other DNOs and researchers developing or running trials with residential customers.

In order to successfully engage and support the trial participants in achieving their energy saving potential, it is necessary to gain a greater understanding of household demographics and their specific needs. The project has gathered valuable insights on the customer base participating in the trials through the analysis of two energy surveys, four customer panels, 30 telephone interviews and 159 notes of conversations with residents.

The demographic analysis has shown that the majority of the **energywise** participants are Bangladeshi (with a large representation of 154 households out of 278 survey respondents) or White British (58 out of 278). This is reflected in the primary language spoken at home, being mainly English, Bengali or a combination of the two.

The households participating in the **energywise** trial are, on average, larger than that typically observed in the UK population, showing a broad age distribution with some potentially vulnerable households having at least one child

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<sup>1</sup> [https://www.ofgem.gov.uk/sites/default/files/docs/2015/10/eco2\\_measures\\_table\\_-\\_oct\\_2015-\\_v2\\_3\\_-\\_final.pdf](https://www.ofgem.gov.uk/sites/default/files/docs/2015/10/eco2_measures_table_-_oct_2015-_v2_3_-_final.pdf)

under 5 and/or elderly customers above 65. Income is generally low, with several households receiving housing benefits, child benefits, income support and/or other state benefits.

The distribution of participants across different ethnic groups and age bands, together with the high volume of participants speaking Bengali as their primary language (114 out of 278 respondents), suggests that the **energywise** recruitment and engagement strategy was an inclusive one and that the project's innovative approach based on partnership with trusted local intermediaries that possess local awareness and language skills was suitable for the target population.

The report also summarises key findings from the Energy Social Capital survey administered to trial participants to investigate the level of trust of trial participants in general and within the trial area, their attitude regarding seeking energy advice and towards the energy saving technologies provided by the project. Capturing any feedback they may have on **energywise** and understanding who they trust and where they would turn to for energy advice and information is important for shaping the ToU tariff trial on this project and for constantly improving the project's engagement strategy.

These findings do not only inform the **energywise** trials, but also will inform the industry on best practises for engaging hard-to-reach and diverse customers in the smart meter roll-out and similar energy efficiency campaigns. Given the diversity of Great Britain's population, an inclusive approach will support the Government's target of fitting 53 million smart meters in over 30 million premises (households and businesses) by the end of 2020.

The assessment of the energy saving achieved through the delivery of Trial 1 interventions to fuel poor households shows a 3.3% average reduction in electricity consumption within the intervention group when compared to the control group as a result of Trial 1 interventions. This result is statistically significant at the level set out in the project bid (0.75 statistical power level for differentiating between the intervention and control group).

This is an important insight which helps quantify the energy saving potential of fuel poor customers in response to smart meters (smart energy displays) and the other energy saving interventions provided in this trial, and further develops the overall evidence base relating to consumer engagement with smart meters. The fuel poor demographic seems to save similar amounts of energy to other demographic segments in society when presented with a smart meter<sup>2</sup>.

The 3.3% savings translate to an average reduction of 23 W during the evening peak window (17:00 – 22:30), which represents about a 5.2% reduction in average evening peak demand per household, and reflects the capacity for meaningful engagement with energy savings by the trial participants.

When assessing the network impacts that could be achieved if the **energywise** Trial 1 energy savings were realised by all households classified as fuel poor within the UK Power Networks licence areas, an estimated total annual reduction in electricity consumption of 56 GWh could be achieved across the three licence areas. This corresponds to an average reduction in the evening network load of approximately 14 MW.

Finally, in comparison with previous trials, it can be seen that the average annual consumption of the **energywise** trial participants is considerably lower than that observed in other projects, such as the Low Carbon London (LCL) and Customer Led Network Revolution (CLNR) trials. This is in line with the LCL trial results that highlighted the impacts of household income on annual electricity consumption and maximum household demand, and reflects the demographic composition of the participants in the **energywise** study, which is targeted at fuel poor customers.

Additional customer insights on a broad range of topics including the use of heating and topping-up of prepayment meters have been also captured through different channels of interaction with trial participants. These are important for contextualising participant energy consumption and to inform the energy saving and shifting analysis. For instance, the project has gathered anecdotal evidence of different electricity usage patterns, such as the use of secondary electric heaters and the movement of extended family members between households. These habits

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<sup>2</sup> DECC (2015) 'Smart Metering Early Learning Project: Domestic Energy Consumption Analysis - Report and Technical Annex'. The energy savings reported by DECC apply for standard SMETS1 electricity smart meter. The study does not include the additional energy saving interventions provided by the **energywise** project.



are important anecdotal observations as they might have an influence on the pattern of electricity consumption, but also the appliance ownership in the home.

The report is structured as follows:

- Section 1 is this Executive Summary of the report;
- Section 2 provides an overview of the project and its objective, the trial design that has been developed in order to achieve these objectives and the innovative learnings that are expected to be gained through the trials;
- Section 3 summarises the way the project identified potentially fuel poor customers and describes the type of households recruited to the project, reporting the analysis of the data collected via two research surveys;
- Sections 4 introduces Trial 1 with an overview of the energy efficiency interventions and their provision to trial participants during the installation phase of the project; the successful demonstration of the innovative Multi Dwelling Unit (MDU) Communication Infrastructure to commission smart meter sets to tall and difficult buildings is also illustrated;
- Sections 5 and 6 present the analysis of 12 months of electricity and network data from Trial 1 along with the accompanying learnings gained;
- Section 7 illustrates the technical potential associated with Trial 1 interventions and discusses this in relation to the actual savings observed for Trial 1;
- Section 8 discussed the outcomes of the customer protection measures put in place to ensure that the project follows the principle of 'do no harm' in terms of its participants;
- Section 9 summarises the key lessons captured through the set-up and operational phases of Trial 1, as well as the research study and interactions with trial participants; and
- Appendix A details the selection strategy for the external control group.

## 2 Introduction

### 2.1 The Project



Figure 1: Project Brand

The Vulnerable Customers and Energy Efficiency (VCEE) project also known as **energywise** is a partnership between ten organisations, led by UK Power Networks. Ofgem awarded the project £3.3 million of funding, under the LCNF competition scheme in December 2013.

**energywise** is exploring how residential customers who may be struggling with fuel bills can better manage their household energy usage and consequently their energy bills by changing the way they use electricity. The project is doing this by undertaking a research study with the aim to recruit 550 households who may be struggling with their energy bills in the London Borough of Tower Hamlets and carrying out two trials. The trials will test different ways of helping households better understand and control their electricity spending, enabling them to make changes which may save them money on their energy bills.

Firstly, the project is currently exploring whether households benefit from smart metering solutions (smart meter and smart energy display) and from energy efficiency technologies such as energy efficient light bulbs, an eco-kettle and standby saver.

Second, the project will work to understand households' appetite to change their behaviour when on a 'time of use (ToU)' tariff targeting electricity, with favourable rates within specific time windows.

The project plans to understand:

- The extent to which this residential customer group is able and willing to engage in energy saving campaigns and a ToU tariff;
- The benefits that they can realise from their change of behaviour in household energy management;
- The challenges and best approaches to engaging with these groups of customers to achieve these aims; and
- Whether their reduction in demand, and shifting demand away from network peak periods may benefit the electricity network by deferring or avoiding network reinforcement.

This report addresses the potential changes in household energy management behaviour, and the associated network benefits, that can be realised by customers that may struggle with their energy bills when provided with smart metering solutions and engaged in energy saving initiatives. It also illustrates key insights into the demographics of trial participants, the way they use energy, their level of trust in the area and their attitude towards energy advice seeking and energy saving technologies; as a result, the report provides a greater understanding into this customer base that will inform best practises to engaging hard-to-reach customers in the smart meter roll-out and similar energy efficiency campaigns.






Figure 2: Project's Strapline

## 2.2 Project Partnership

energywise is a partnership between ten originations led by UK Power Networks:

Project Partner	Role in Project
 <p>UK Power Networks Delivering your electricity</p>	<p>UK Power Networks owns, operates and manages three of the fourteen electricity distribution networks in Great Britain, delivering electricity to over eight million customers in London, East and the South East of England. UK Power Networks own the licensed distributors London Power Networks plc, Eastern Power Networks plc and South Eastern Power Networks plc. UK Power Networks is a network operator and does not generate or buy electricity nor does it sell to end customers. UK Power Networks' networks operate in the most challenging, fastest growing, and highest cost part of the country.</p> <p>UK Power Networks takes electricity at high voltages from the National Grid and transforms it down to voltages suitable for commercial and domestic use.</p>
 <p>British Gas</p>	<p>The role of British Gas in the project is related to technical enablement and will provide the smart meters, smart energy display (SED), and ToU tariff required for the targeted customer group to engage with demand side response. British Gas will also install (in cooperation with its contractors) the appropriate communication infrastructure required at households that require a communications solution for installing smart meters and smart energy displays in complex Multiple Dwelling Units (MDU) with challenging meter arrangements. Please note British Gas are providing considerable in-kind funding to the project.</p>
 <p>UCL</p>	<p>Since its foundation in 2009 UCL-Energy has developed a strong national and international reputation for research in energy demand and energy systems. University College London is the research authority of the project and its aim is to ensure that the results of the trials are statistically rigorous and the findings could be replicated in future.</p>
 <p>Tower Hamlets Homes</p>	<p>Tower Hamlets Homes is the arm's length management organisation of the London Borough of Tower Hamlets, managing the council's housing stock on its behalf. Tower Hamlets Homes has provided a list of eligible tenants, along with insights into the area and local intelligence that has shaped the customer engagement strategy.</p>
 <p>POPLAR HARCA Making Poplar a better place to live</p>	<p>Poplar HARCA is a registered social landlord that operates as an independent non-profit charity in the London Borough of Tower Hamlets, separate from the local authority. Poplar HARCA has provided a list of eligible tenants. They will also provide insights into the area and local intelligence that has shaped the customer engagement strategy.</p>
 <p>bromley by bow centre</p>	<p>Bromley by Bow community Centre is a local charity established in 1984 by Andrew and Susan Mawson and has built up considerable goodwill in the area. They are the employer of the project's customer field officer (CFO) team, which is going to be a team dedicated to the recruitment and engagement with the trial participants (prospective and actual).</p>

Project Partner	Role in Project
	CAG Consultants is a sustainability, climate change and community engagement consultancy which is going to represent the voice of the customer in the project. CAG Consultants will provide specialist support, guidance, mentoring, training and evaluation of recruitment and engagement with vulnerable and fuel poor customers.
 Action for Warm Homes	NEA is the national fuel poverty charity which aims to eradicate fuel poverty and campaigns for greater investment in energy efficiency to help those who are poor and vulnerable. NEA will provide expertise in energy efficiency and customer focus due to its continuous engagement with fuel poor customers.
	Element Energy is a strategic energy consultancy specialising in the intelligent analysis of low-carbon energy across the sectors of power generation and distribution, transport and buildings. Element Energy will provide the analysis of the network impacts of the energy saving and energy shifting interventions through network modelling within the trial area.

## 2.3 Project overview

The project is engaging fuel poor customers to understand how they can benefit from energy efficiency measures<sup>3</sup> and whether they can reduce their electricity consumption at peak times through a ToU tariff (known as 'DSR'), generating both customer and network benefits.

As of 12 April 2017, 294 participants are actively participating in the project, which are all social housing tenants in the London Borough of Tower Hamlets apart from one leaseholder. **energywise** is structured in two trials:

- **Trial 1**, which commenced in 2015 and was completed on 14 February 2016, involves smart meters and energy saving devices (including three LED light bulbs, one eco-kettle and one standby-saver device). It aims to identify the magnitude of energy savings and the impact on the electricity network when customers have access to smart meters, smart energy displays, simple affordable energy saving devices and energy saving advice with existing tariffs.
- **Trial 2**, which commenced on 1 April 2017, involves giving participants a ToU electricity tariff or rebate. It aims to assess the level, and impact on the network, of demand shifting achieved through the introduction of a ToU tariff or rebate in parallel with energy-saving activities.

### Trial design

Figure 3 illustrates the research design of the two trials: trial participants are randomly allocated to two groups, group 1 (intervention) and group 2 (control). By the beginning of Trial 2, both groups receive the same interventions (highlighted in pink and orange) but at different times:

- intervention group (illustrated in pink) received the smart metering solution and the energy efficiency pack at the beginning of Trial 1 and will receive the DSR interventions in Trial 2;
- control group (illustrated in orange) will receive all interventions at the end of Trial 2 (energy efficiency devices) or before the start of Trial 2 (smart metering solution).

At the beginning of Trial 1 temperature monitoring equipment was also installed in all participants' properties and two research surveys, the Energy Social Capital (ESC) survey and the Home Energy survey (HES), were carried

<sup>3</sup> In this report the term 'energy efficiency' also encompasses 'energy conservation'.



out with both groups. The ESC survey will be administered again between the two trials and at the end of Trial 2 in order to identify any evolution of the research findings throughout the project.

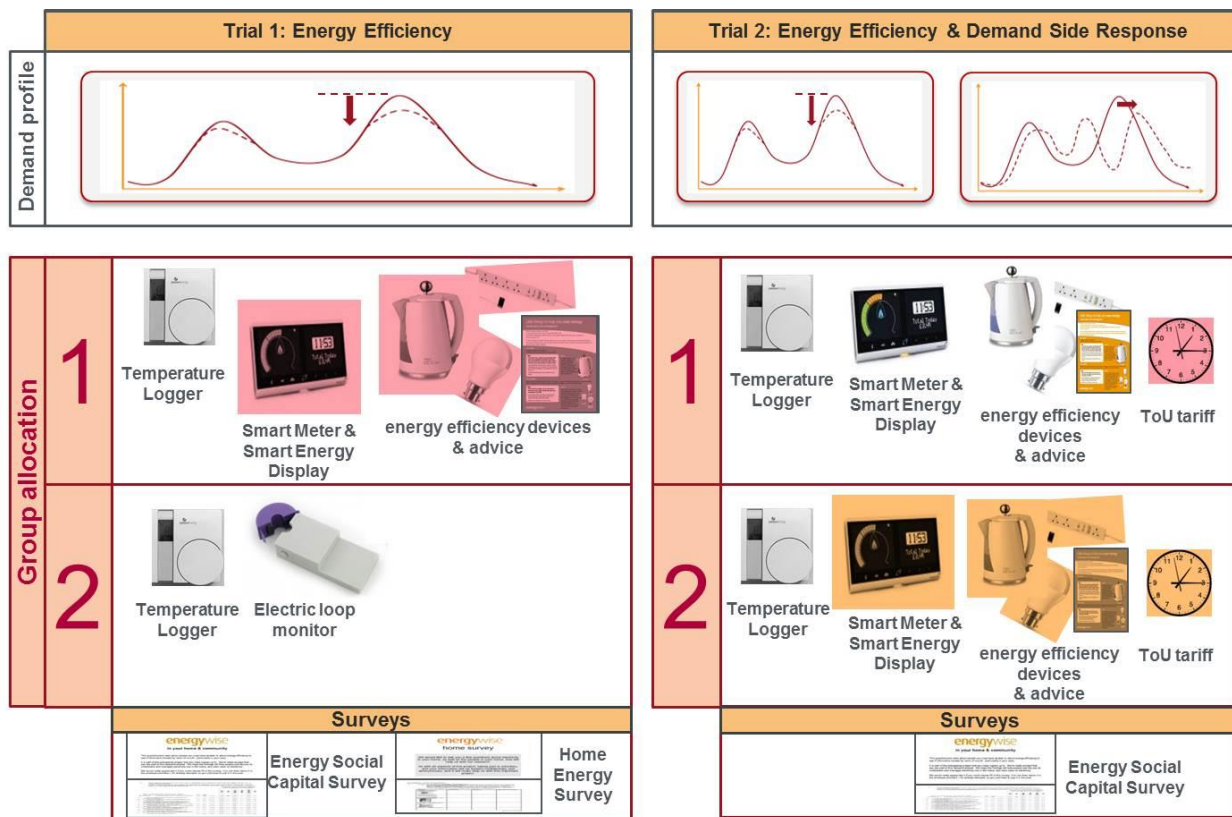


Figure 3: Customer journey for group 1 and group 2 participants within project trials

## 2.4 Project aims and objectives

The aim of the project is to understand how fuel poor households can benefit from smart meters, smart energy displays and energy efficiency appliances, and also how they respond to ToU electricity tariffs. The project has three specific objectives:

- **Engage fuel poor customers to understand how they can benefit from energy efficiency and participate in demand side response.** Reducing electricity consumption may result in lower bills and could thus assist in reducing the likelihood of these households being in fuel poverty or the depth of their fuel poverty.
- **Quantify the demand reduction and time-shifting that these customers could provide.** Quantification is vital if initiatives like energywise are to attract similar status to other proven interventions such as cavity wall insulation and low energy lightbulbs. The peak time for electricity consumption

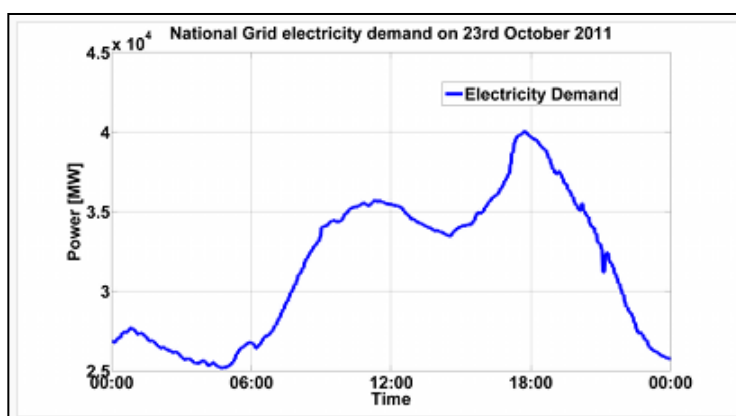


Figure 4: Electricity demand over a 24h period



in the UK is typically between 5 and 8pm for domestic customers<sup>4</sup>. Figure 4 shows how electricity demand in the UK varies over a typical day<sup>5</sup>. Limited direct research has been conducted in the electricity profile of the fuel poor domestic customer group and one of the project aims is to improve understanding of the demand profile of this domestic customer group in Trial 1 and based on this understanding develop an appropriate ToU tariff(s) for use in Trial 2.

- **Understand the challenges and best approaches to engaging with this group of customers.** It is frequently argued that fuel poor customers require additional help and support to engage with smart meters and energy efficiency devices in order to enable them to access the benefits of these. UK Power Networks found that in the LCL trials, those living in areas categorised as being 'Inner City Adversity' were the most likely to refuse a smart meter, stating that they felt it was too technical or confusing. The project is investigating how existing social networks, which fuel poor households trust, can be identified and used to effectively engage these customers in the adoption and use of smart metering technologies. It also investigates what engagement materials and communication channels are most effective in engaging with and supporting these customers.

The project will provide DNOs and suppliers with evidence-based learning on how to work with third party agencies to deliver energy efficiency and demand side response campaigns to fuel poor customers. It will also determine the extent to which fuel poor customers are willing and able to provide demand reduction and time-shifting services to alleviate network constraints and whether this is material.

LCL project found that there are sizeable opportunities for lower income households to reduce energy use, particularly at peak times, through changes to their lighting and appliances, particularly in households of three or more people. Moreover, research carried out for DECC and Defra, using data from 250 households, estimates that fuel poor households have the technical potential to reduce their demand by an average of around 650 kWh per year<sup>6</sup>. Analysis of these figures suggest that a peak shift for fuel poor households of up to 200 MVA across Great Britain is technically possible<sup>7</sup>; this is the equivalent to the output from a small-to-medium sized power station. These figures were based on owner occupiers whereas **energywise** focuses on social housing tenants; this project is contributing to fill this gap in data. They are also based on assumptions about occupant behaviour rather than observations and thus are not strictly speaking comparable with the findings of field trials.

## 2.5 How is the project breaking new ground?

The project is breaking new ground in a number of areas:

- **Customer insights:** Exploring how fuel poor customers can respond to energy efficiency measures, smart meter information and price signals in order for them to reduce their energy bills. The project is also investigating what opportunities can be created for the customers through an end-to-end coordinated approach between different parties in the value chain. Also, the needs of the fuel poor will be further analysed, identified and profiled and such learning can tailor services offered.
- **Network insights:** Investigating the ability of fuel poor customers to reduce and shift their electricity consumption away from peak times and establishing whether the impact of this is significant enough to defer network reinforcement. The project will support suppliers and DNOs in realising this potential contribution in a sustained manner, thus helping DNOs to manage the increasing and uncertain demands on the network.
- **Customer recruitment & engagement:** Establishing how best to engage with fuel poor customers on energy efficiency and demand response including the most effective messages and approaches. In addition, the project is going to provide insights on the challenges faced and best practises

<sup>4</sup> Elexon 2013 'Load Profiles and their use in Electricity Settlement' [https://www.elexon.co.uk/wp-content/uploads/2013/11/load\\_profiles\\_v2.0.cgi.pdf](https://www.elexon.co.uk/wp-content/uploads/2013/11/load_profiles_v2.0.cgi.pdf)

<sup>5</sup> Based on National Grid data prepared by Glasgow University - <http://www.physics.gla.ac.uk/~shild/grid2025challenge/data.html>

<sup>6</sup> Source: DECC, Defra and the EST (2012), "Household Electricity Survey: A study of domestic electrical product usage".

<sup>7</sup> Low Carbon Networks Fund submission from UK Power Networks – Vulnerable Customers and Energy Efficiency, 28th November 2013

identified when recruiting and engaging with fuel poor customers and this learning will be used in order to tailor the services offered from the DNO and other stakeholders participating in the project.

- **Innovative partnerships:** Exploring the effectiveness of DNOs and energy suppliers working with trusted local organisations who support those in fuel poverty and whether and how this can result in fuel poor customers being better served. The project lessons learnt will provide recommendations on how DNOs can work collaboratively with electricity suppliers and community actors to better identify, understand the needs, assist and deliver services to the fuel poor, within existing obligations.
- **Non-punitive time of use tariffs:** One key area of innovation in the project is trialling both credit and prepayment non-punitive time of use tariffs with fuel poor customers. Trial 2 will provide learnings on efficacy and consumer acceptability of this class of tariff that is emerging as commercially viable and consumer acceptable time of use tariff structure for this customer segment. Only punitive tariff structures have been trialled in LCNF projects to date (e.g. CLNR and LCL). Having quantitative and qualitative data on fuel poor customers' responses to such non-punitive tariffs is critical to the understanding and evolution of this class of tariffs in Great Britain.

As part of the project, the energy supplier British Gas is also exploring the effectiveness of working with local and trusted third parties such as the housing provider and community centre in order to carry out a locally targeted, community-led installation programme of smart meters. It is anticipated that this approach will lead to improved access rates for British Gas' Smart Energy Experts, greater community engagement and increased customer awareness of the benefits of smart metering, whilst lowering missed appointment and no-access rates.

#### Smart meter roll-out insights

The project also involves testing key parts of the smart meter infrastructure, including prepayment smart meters and the benefits they can bring to customers (such as remote top up) and how best to roll out smart meters in multiple dwelling units (which present a number of technical challenges):

- **Prepayment smart meters:** As part of **energywise**, British Gas is testing its first SMETS1<sup>8</sup> compliant smart meters with prepayment functionality, outside their trial environment (with 66 prepayment smart meters installed so far in Trial 1). This is providing an opportunity to gain valuable early learning as to the extent prepayment customers engage with smart meters and how they use their smart energy displays to manage their consumption and their budget. Smart prepayment will also open up new, more convenient payment options to customers (e.g. over the telephone, online or via their in-home display), meaning they no longer have to worry about losing their key card.
- **Multiple Dwelling Units (MDU):** Communications between meters in basements and displays in the home – in Trial 1, British Gas has installed a communications backbone into a block of flats where the meters are contained in a communal meter room in the basement, remote from the flats in which the residents themselves live and will be using their in-home displays. Within the Smart Metering programme, these are referred to as Multi Dwelling Units (MDUs) and are a known challenge for the roll-out. This communications backbone enables the smart meter Home Area Network (HAN) services to be received by the recruited households located on different floors of the building. These households would not otherwise have been able to fully access the benefits of the smart metering solution. This provides valuable technical learning, but also gives insight into the cost of this type of infrastructure as well as the commercial arrangements required between energy supplier, landlord and customer. This is something that has not been fully resolved as part of the smart meter implementation programme and the demonstration carried out in Trial 1 is resulting in the UK's first end to end installation of residential smart meter sets operating across a MDU/tall and difficult building solution, thus informing the market.

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<sup>8</sup> SMETS1 are the first version of the Smart Meter Equipment Technical Specifications.

### 3 Trial participants

This chapter provides an introduction to the **energywise** trial participants, illustrating how they have been selected, recruited and allocated to the intervention and control groups. It also presents key insights gathered through research surveys that provide a portrait of the type of households involved in the project.

In order to understand the demographic of the trial participants and to contextualise their energy consumption, two surveys were developed by University College London:

- **Home Energy Survey** (Section 3.3), which contains variables relating to ownership of many energy-consuming devices (e.g. wet and cold appliances and white goods, TVs, computing, lighting) and socio-demographic variables relating to the household (e.g. household size, ethnicity, primary language, income).
- **Energy Social Capital Survey** (Section 3.4), which investigates both individual and collective energy social capital of **energywise** households.

#### 3.1 Selection and recruitment of trial participants

##### 3.1.1 Selection criteria

The project has adopted the 'Low Income High Cost' (LIHC) definition of fuel poverty, where a household is considered to be fuel poor if the residents would have fuel costs above the national median level if they were to heat their homes to the designated levels, and were they to spend that amount on fuel they would be left with a residual income below the official poverty line<sup>9</sup>. However, the project will also assess participants' fuel poverty status in accordance with the 10% definition for comparative purposes as Government measures using this indicator.

To accurately determine whether a household is fuel poor would require information on the construction of the property, technology performance (e.g. boiler efficiency), household characteristics and fuel costs. In the absence of having all this information and due to the lack of publicly available data on households' income and fuel costs, a series of proxies have been used to identify the fuel poor.

As discussed in the SDRC 9.1 and 9.2 reports, the inclusion criteria selected by the project to target eligible households are the following:

- British Gas dual fuel customers<sup>10</sup>;
- Social tenants of either Poplar HARCA or Tower Hamlets Homes;
- Gas heated properties; and
- Property EPC rated C, D, E, F or G (generally speaking, this range of EPC ratings excludes those properties that have double glazing, cavity wall insulation and loft insulation).

In addition, **energywise** defined a series of criteria for exclusion of households from the project:

- Households that have had energy efficiency improvements since October 2013;
- Households that are known to be scheduled to have energy efficiency improvements over the course of the project;
- Households scheduled for demolition over the course of the project;
- Leaseholders and other non-social tenants<sup>11</sup>;
- Households for which British Gas does not have annualised electricity consumption data for the year ahead of the pilot study;

<sup>9</sup> Department of Energy and Climate Change (DECC), "Annual Report on Fuel Poverty Statistics, 2013," London.

<sup>10</sup> To maximise participant volumes the project had to relax this criterion and utilised British Gas customers who had either their electricity only, or electricity and gas supplied by British Gas. Only customers with both gas and electricity supply to their property (regardless of the gas supplier) were eligible for the project. Those customers who did not have a gas supply and resided in properties that were electricity supply only (i.e. electrical heating and/or electrically operated hot water/hot water storage) were excluded from the project.

<sup>11</sup> One leaseholder has been included in the project to demonstrate the MDU Communication Infrastructure, as illustrated in Section 3.1.2.

- Households that were occupied by another tenant the year before Trial 1;
- Households that have Economy 7 tariff (and circuit) for electricity;
- Households that rely on communal heating, district heating or other form of heating that does not include individual gas meter;
- Households that have given notice to British Gas to switch supplier;
- Households vulnerable to power cuts, especially those who are blind, visually impaired or reliant on medical equipment. These households were excluded during the selection process if the information was available to British Gas at that time (see Section 8.1.2 for the review of vulnerable households post consent); and
- Households with properties in a MDU apart from those in the tower block selected to install the MDU solution trialled by the project (Padstow House).

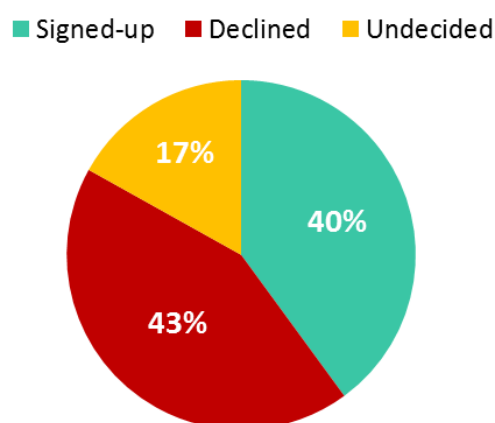
Finally, a series of additional exclusion criteria were applied by British Gas to remove customers that could not take part to the project:

- Households who were highlighted as “seriously ill”, or “confined to bed”;
- Households with a change of tenancy in progress;
- Households that requested to be excluded/opted out of receiving marketing materials;
- Deceased customers;
- Households having a theft history;
- Independent Gas Transporter Sites (IGTs) that develop, operate and maintain local gas transportation networks;
- Multiple meters (more than one meter per household (sub metering));
- Occupier accounts (no name on account);
- Three phase meters (mostly used in industrial and large commercial settings where powerful appliances are powered);
- U16 meters (large capacity gas meter).

Further to the identification of eligible households based on the previously mentioned criterions, the identified properties have been also categorised and selected by British Gas according to their metering arrangements in order to ensure the feasibility of each eligible household for smart meter installation.

### 3.1.2 Trial 1 recruitment

As a result of the selection process, a total of 1,342 households have been approached as part of the recruitment phase between the beginning of May and mid-August 2015 (with the last customers signing up on 22 October 2015) following the protocols described in the SDRC 9.1 report and in the previous progress reports. Out of the 1,342 households approached, 536 signed up to the project, resulting in a 40% response rate, which exceeded the project target of 33%. 579 households (43% of the 1,342 approached) said they were not interested in the project, while 227 households never expressed a definitive decision about participating in **energywise** (Figure 5). When calculating the response rate for each sub-category, a similar response rate was observed between Tower Hamlets Homes (40%) and Poplar HARCA (39%) tenants, while prepayment customers have responded slightly more positively to the project (44%) compared to credit metered households (38%).



**Figure 5: Trial 1 recruitment response rate**



As part of the recruitment of the 1,342 approached households, the project successfully recruited three households with properties in Padstow House, the MDU selected for testing the MDU communications infrastructure; however, it was found that two of these three did not require the MDU communication infrastructure as the flats were located adjacent to, or directly above meter rooms. The third customer had borderline Zigbee signal so may or may not require the MDU solution but was later disengaged by the project due to other ineligibility reasons.

In order to ensure robust project learnings around the innovative MDU communication infrastructure for tall and difficult buildings, British Gas re-ran the customer list within Padstow House and highlighted 10 additional customers that could potentially join Trial 1. Four of these customers matched all eligibility criteria but six were leaseholders. The project decided to allow leaseholders to be recruited only under these specific circumstances to maximise take up and demonstrate the effectiveness of the MDU communication infrastructure. Any leaseholder recruited for the purpose of testing this innovative solution will be flagged up in all project trackers and data analysis to make sure that they are treated appropriately in any assessments. This second wave of recruitment was conducted from the end of March 2016 until 18 April 2016 and successfully signed up two customers (one of which is a leaseholder) who require the MDU solution to benefit from smart meters resulting in a total of 538 sign-ups to the project.

In total five households in Padstow House were successfully recruited for the project, of which two are eligible for the MDU, two do not require the MDU solution and one was removed due to ineligibility reasons.

### 3.1.3 Random allocation

The recruited households were randomly allocated to group 1 (intervention) or group 2 (control), following the random allocation process designed by the research partner. The households recruited within Padstow House were assigned to the intervention group in order to test the MDU solution.

As of 27 April 2017, 244 households have dropped out from the project, which are split slightly unevenly between the intervention (113) and control (131) groups, resulting in 160 active participants in the intervention group and 134 participants in the control group (as shown in Table 1). With 244 confirmed drop-outs, the total number of active participants to date in Trial 1 amounts to 294 households, of which 251 are Tower Hamlets Homes tenants and 43 are Poplar HARCA tenants, while 198 are credit customers versus 96 prepayment customers.

**Table 1: Breakdown of Trial 1 participants into intervention and control group**

Payment Method	Intervention	Control	Current Total
Credit	104	94	198
Prepayment	56	40	96
Grand Total	160	134	294

At the completion of Trial 1 on 14 February 2017, 297 households were still part of the trial, with 161 active participants in the intervention group (105 credit and 56 prepayment customers) and 136 in the control group (95 credit and 41 prepayment customers). The results presented in this report are based on the best dataset available for the type of analysis undertaken. Specifically:

- The **quantitative analysis of the electricity data** is based on daily reads and is carried out over the first 12 months of Trial 1. For each participant, the first 365 days are taken into account, starting at their individual installation date. Data from participants that dropped out from the project before their 365 days were completed was removed from Trial 1 electricity data analysis.
- The **network modelling** used all the available half hourly data available between 15 February 2016 (when the smart half hourly data issue was fixed for credit meters – see lesson learnt L7.4 in Section 9.7) and February 2017. Data from participants that dropped out before 15 February 2017 was removed from the dataset. Exclusion criteria were also applied for households who do not have a pre-trial Estimated Annual Consumption, those that were classified as outliers in the



energy saving analysis and (see Section 5.2.1) and those transmitting clearly erroneous half hourly data.

- The insights collected through the **research surveys** are based on the data available from a sample of 337 trial participants, those still active as of 31 January 2016, as the analysis was conducted at the beginning of 2016. Out of these, 173 were in intervention group and 164 in control group, while 218 were credit customers and 119 prepayment customers.

### 3.2 EPC rating

Figure 6 shows the distribution of all 538 properties that signed up to the project into Energy Performance Certificate (EPC) rating bands C-G. Overall, 41% are in band C, 41% in band D and 18% in band E to G (with a small number of properties in band F and G). Even though those households that have had energy efficiency improvements since October 2013 have been excluded in the selection, the lack of very inefficient properties may be due to improvement works carried out by the social housing associations before that date. When the EPC ratings were not available, they have been extrapolated against the data available in the social housing associations' databases (e.g. taking the average EPC rating of properties on the same floor or in the same building).

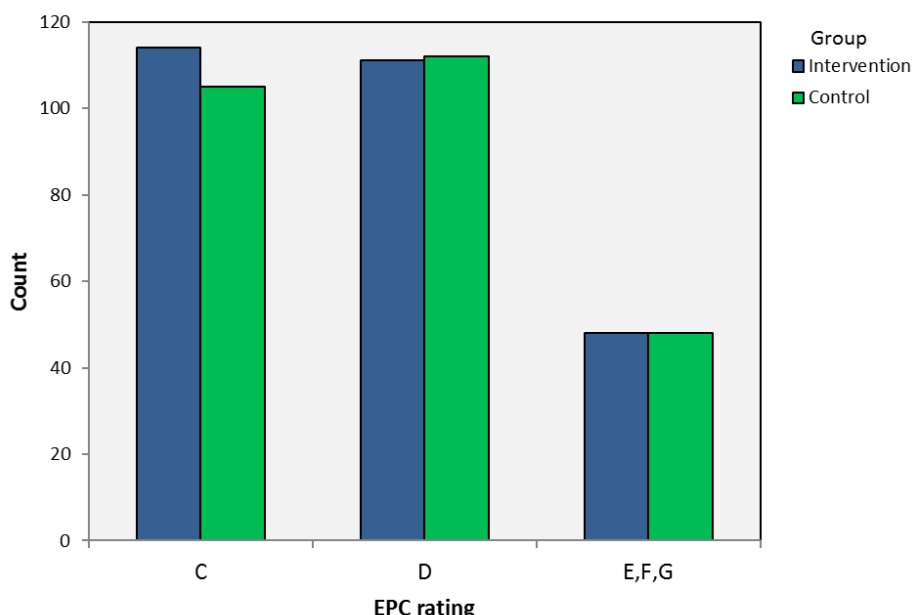


Figure 6: Number of properties in each band of EPC rating

### 3.3 Home Energy Survey

The HES provides insight into many variables relating to ownership of energy-consuming devices (e.g. wet and cold appliances and white goods, TVs, computing, lighting, etc.) and socio-demographic variables relating to the household (e.g. household size, ethnicity, primary language, income, etc.). The survey results are presented in the following sections.

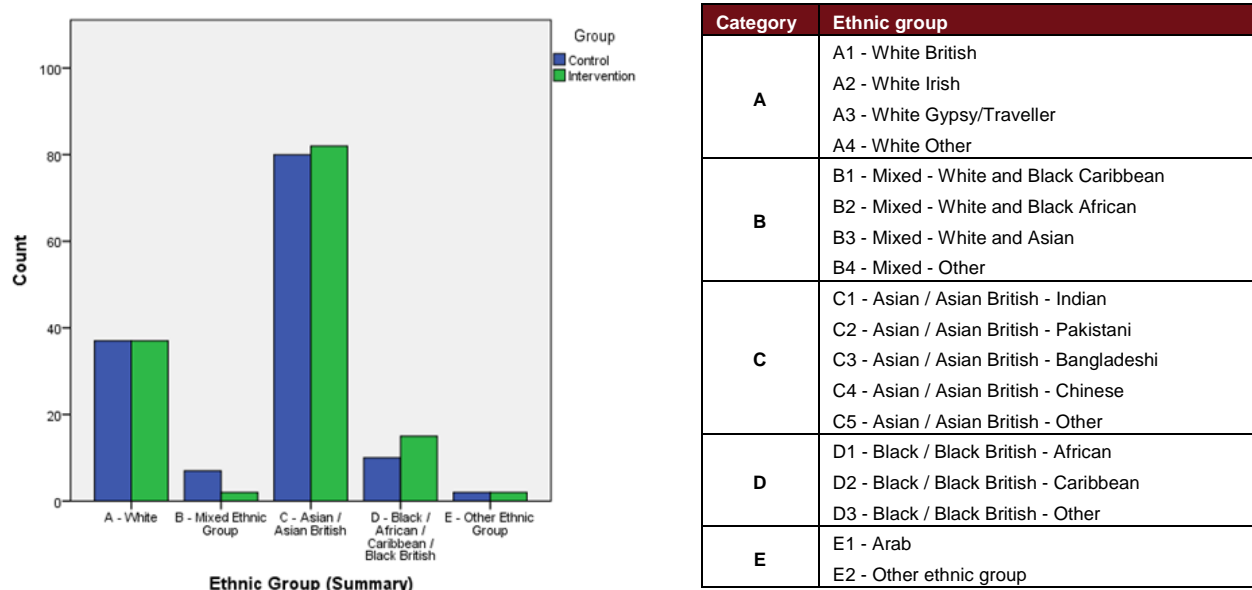
95% of Home Energy Surveys (HES) were completed with customer field officers (CFOs) assisting participants (e.g. counting lightbulbs, identifying appliance-types) with completion of the survey during visits to participants' homes in the installation phase of the project. A small number of surveys (5%) were left with participants for self-completion.

A total of 341 HES have been returned to the project. The analysis of the HES reported in Sections 3.3.1 and 3.3.2 below uses a dataset from 31 January 2016, which included 334 surveys. At this point 56 participants had dropped out of the project and their data was excluded from the results. The analysis is therefore based on the 278 HES eligible for inclusion in the analysis with 138 in the control group and 140 in the intervention group.

### 3.3.1 Demographic analysis

#### Ethnic Group

The distribution of the two largest ethnic groups (Bangladeshi and White-British) in the **energywise** project is relatively evenly split across the intervention and control groups, with 154 Bangladeshi (78 in intervention and 76 in control group) and 68 White-British (35 in intervention and 33 in control group) participants across the two groups out of the 278 households that have completed the survey.

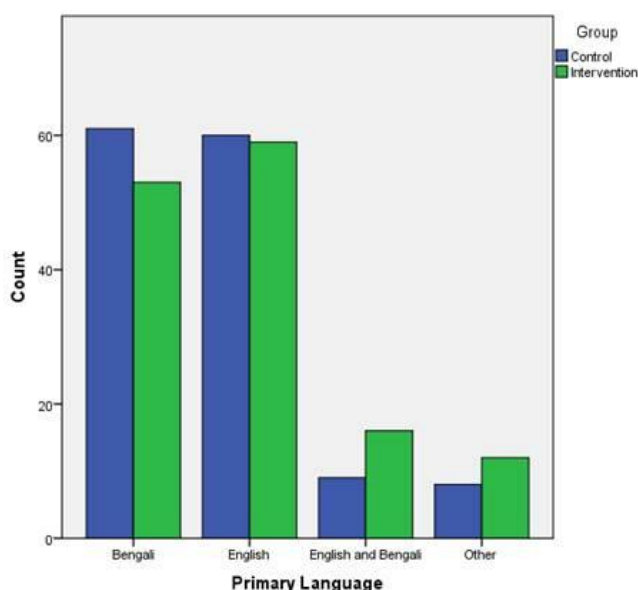


**Figure 7: Distribution of trial participants by ethnic group**

Figure 7 is a summary of the distribution of trial participants by ethnic group. As shown in the table below, White British ethnic group is included in category A, while Bangladeshi in category C.

#### Primary Language

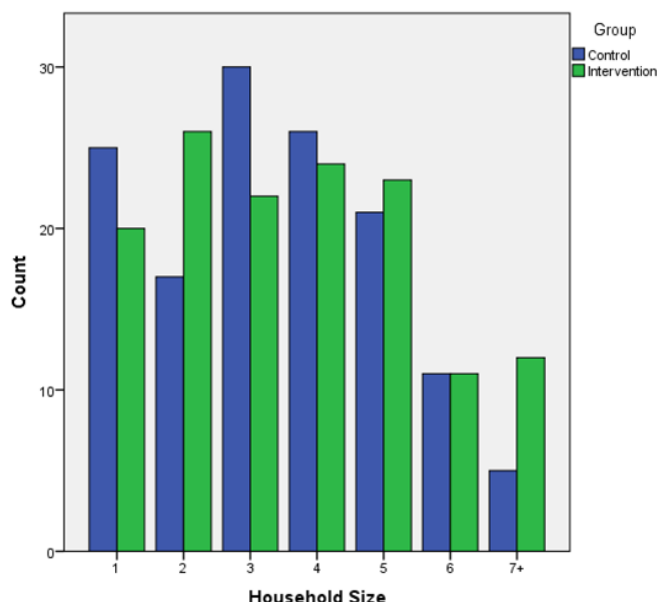
The high proportion of Bangladeshi households is reflected in the high proportion of participant households speaking Bengali as the primary language at home. As per the ethnic group, primary language is relatively evenly split across the intervention and control groups. Out of the 278 participants who have completed the survey, 114 identified Bengali as the primary language at home, 119 said English and 25 indicated both English and Bengali (Figure 8). Other primary languages included for example French, Chinese, Somali and Portuguese.



**Figure 8: Distribution of trial participants by primary language spoken at home**

### Household Size

The participants on the **energywise** project have significantly larger households (mean = 3.53) than the general UK population (mean = 2.38, ONS 2014). The intervention group has a larger average household size than the control group, with more households containing between five and nine individuals in the intervention group while the control group has greater numbers of households of one to four people (Figure 9).

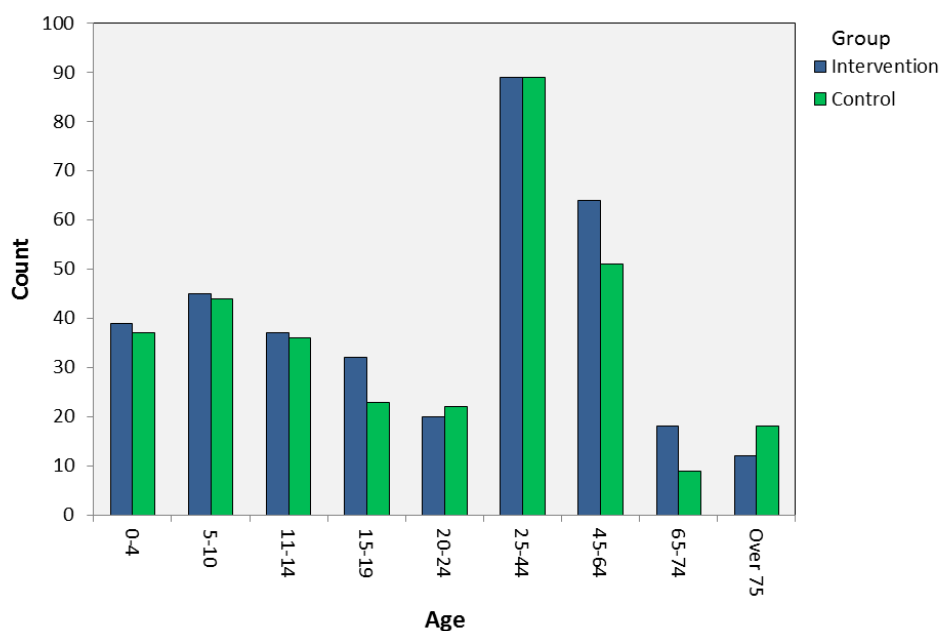


**Figure 9: Number of people per household across intervention and control groups**

### Age

Figure 10 shows the number of households that have one or more residents in each age band. 64% of the 278 participants who completed the survey said that there is at least one member aged between 25 and 44, with an

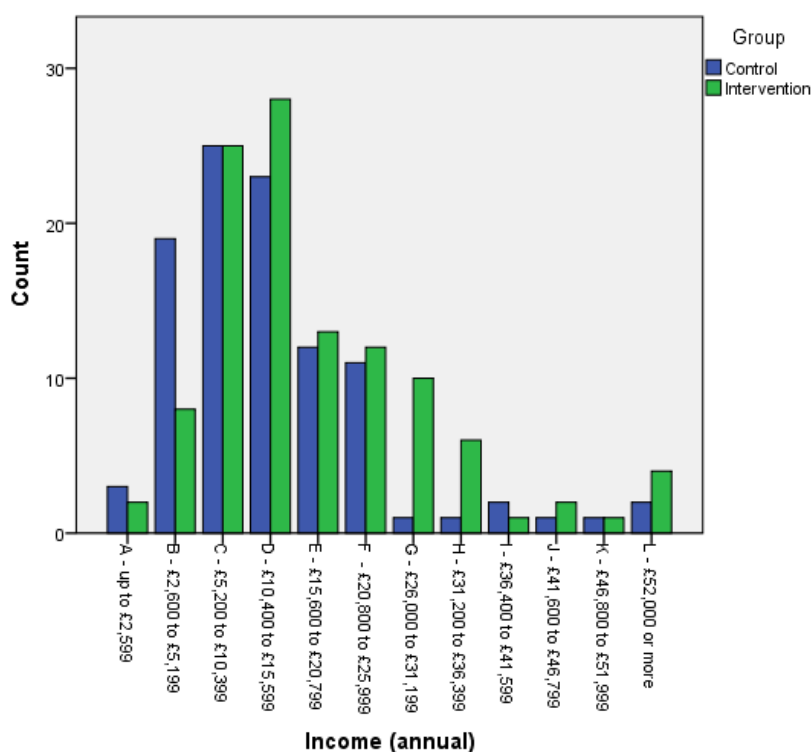
equal representation across intervention and control groups. 76 households (27% of the respondents) have at least one child under five years old, while 57 households have elderly residents. Specifically, 10% of the respondents reported at least one member aged between 65 and 74, while 11% have elderly residents over 75.



**Figure 10: Number of households with one or more residents in each age band**

### Income

As shown in Figure 11, income is unevenly distributed between the intervention and control groups with the control group having higher numbers of households in the lower income bands (A-B) while the intervention group has more households in the higher income bands (G-L).

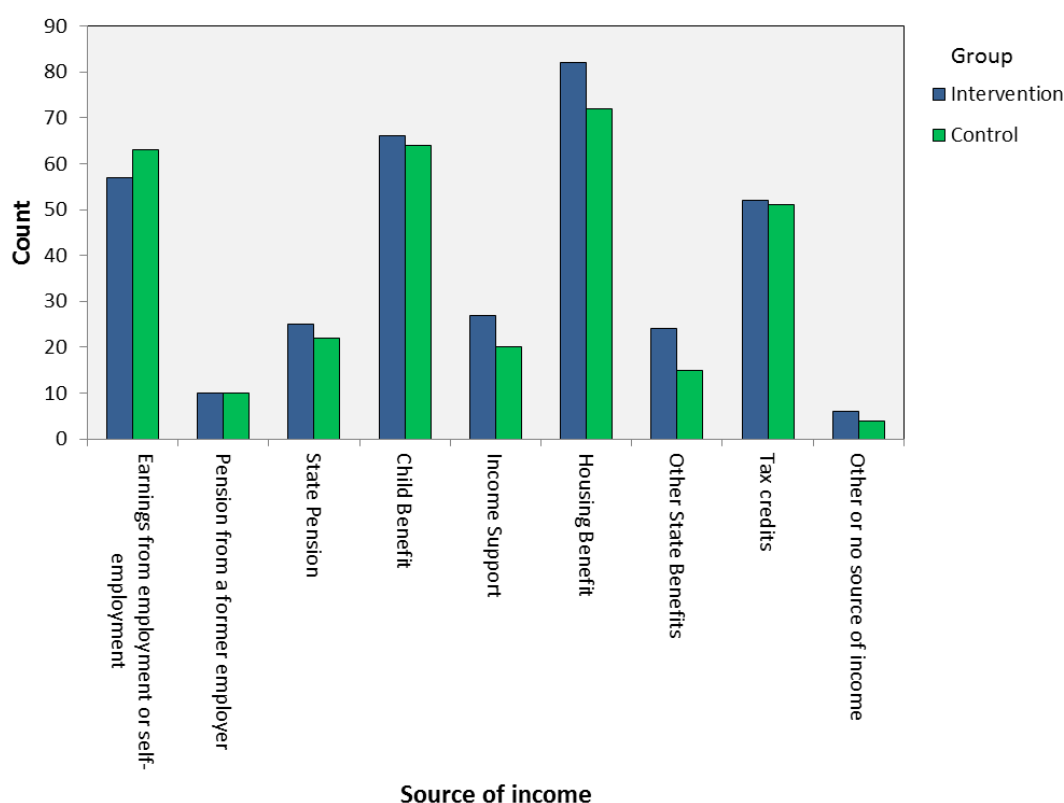


**Figure 11: Income distribution across intervention and control groups**

### Benefits

Figure 12 shows the type of income trial participants are receiving and the proportion of households receiving benefits with an almost even representation across intervention and control groups. In particular, out of the 278 households who have completed the survey, 154 (82 in intervention and 72 in control groups) reported that they are receiving housing benefits and 130 (66 in intervention and 64 in control groups) are receiving child benefit. Also 47 get income support and 39 are in receipt of other state benefits. The categories are not mutually exclusive; therefore, respondents may have indicated more than one category. The 'Other or no source of income' category include 'No source of income', 'Interest from savings', 'Other kinds of regular allowance from outside the household' and 'Other sources (for example rent)'.





**Figure 12: Number of households in receipt of income from each source**

### 3.3.2 Electricity appliance ownership

As shown in Table 2, the intervention group has a slightly higher level of appliance ownership across the various categories, which may merely be a reflection of the higher average household size in the intervention group.

**Table 2: Electric appliance ownership across intervention and control groups**

Electric appliance type	Average number of appliances	
	Control group N=138	Intervention group N=140
Total Lightbulbs	8.41	8.89
Total TVs	1.52	1.58
Total entertainment devices	2.70	2.79
Total computing devices	1.99	2.19
Total ancillary computing devices (e.g. printers etc.)	0.84	0.93
Total mobile chargers	2.70	2.76
Total wet/dry appliances	1.15	1.16
Total cold appliances	1.61	1.64
Total (secondary) electric heaters	0.61	0.59
Average household size	3.40	3.65

### 3.4 Energy Social Capital in the trial area

#### Introduction to Energy Social Capital (ESC)

Social Capital refers to 1) the social networks, trust and reciprocity of a community (collective social capital) or 2) the resources available in a person's social network (individual social capital). The study undertaken in the **energywise** project researches both individual and collective social capital of the study population, but focuses on one type in particular; energy social capital (ESC). ESC is defined as the information resources related to household energy use embedded in social networks (see McMichael 2011<sup>12</sup>). Here ESC is measured through collecting data on:

- Where participants find energy efficiency information;
- Which personal (and non-personal) sources they use to find information; and
- Who participants trust for advice on energy.

This data was collected through a short self-completion survey designed for the project. Additional insights on trusted networks have been collected through a process of local stakeholder engagement, discussed at the end of this section.

#### Survey Administration

As part of the first wave of the Energy Social Capital survey administered at the beginning of Trial 1, 526 ESC surveys have been mailed and 227 have been received back, giving a response rate of 43.2%. The analysis of the ESC surveys reported in this section uses a dataset from 27 March 2016. At this point the team had received 209 ESC surveys, but 30 of these respondents had left the project after returning their survey. The analysis is therefore based on 179 ESC surveys (92 control, 87 intervention).

#### Findings

The findings from the surveys indicate a level of information seeking about energy and a fair amount of 'energy social capital'. That is 146 out of the 179 respondents knew people in their social networks to whom they would turn for energy related advice, and 80 respondents (45%) had had a conversation in the last six months related to electricity. Trust varied through the sampled population, with a majority trusting people in the local area, while only 21% trusting people 'in general'.

The findings this far suggest that electricity usage and energy related issues are not a specific or overwhelming concern for this group, but most have social resources they can turn to if there is an issue they'd like to discuss and many use the media or other organisations as sources of information and advice.

#### Trust

Trust in the local community is high. 63% (113) of the respondents indicated that they trusted people in their area, with 10% (17) of these respondents trusting local people "A lot" (see Figure 13 below). Trust in general is lower than trust in local community. When asked if 'most people can be trusted' only 21% (36) respondents felt this was the case, 34% (60) responded with 'depends', while 42% (74) responded that they felt one "can't be too careful" (see Figure 14). This is slightly below national levels of general trust as found in the Understanding Society survey from 2009 -2010. In this survey, just over a third (35%) of people reported that they would say that most people can be trusted (Sieglar, 2015<sup>13</sup>).

<sup>12</sup> McMichael, M. (2011) Social capital and the diffusion of energy-reducing innovations in UK households. University College London Energy Institute, Bartlett School of Graduate Studies. London, University College London. PhD: 280.

<sup>13</sup> Sieglar, V. (2015) "Measuring National Well-Being - An Analysis of Social Capital in the UK." (January):1–36

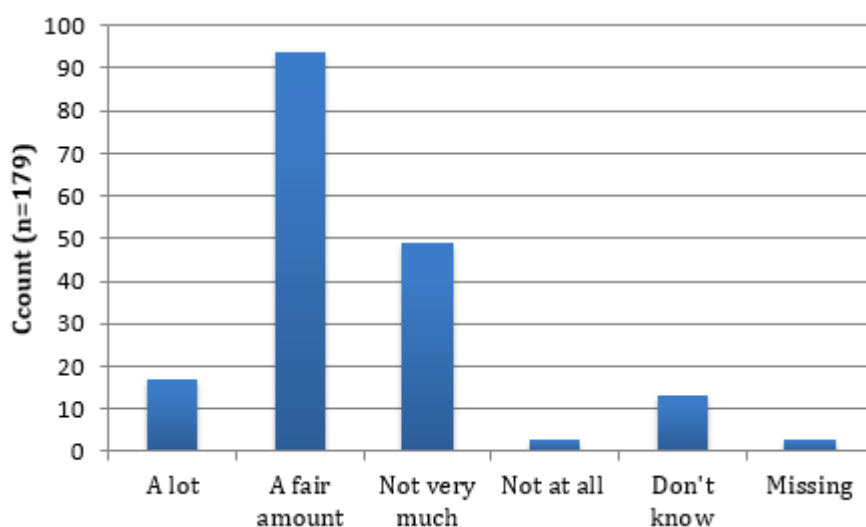


Figure 13: Trust in people in local area

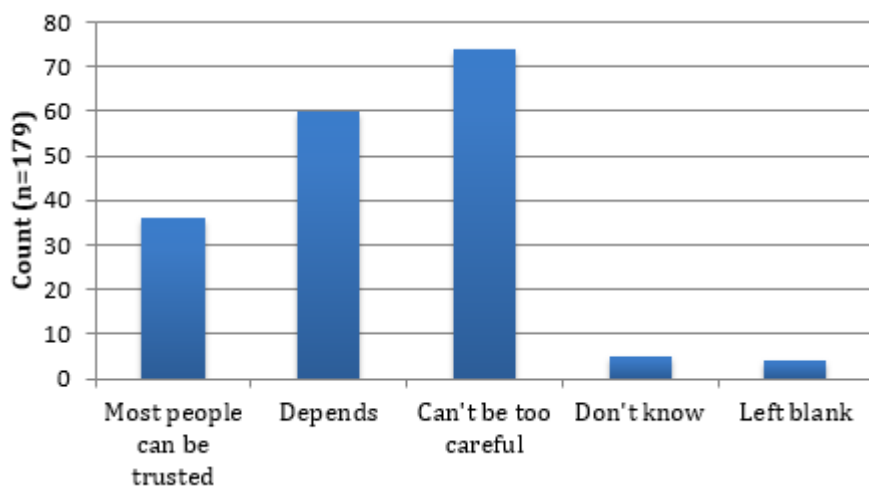
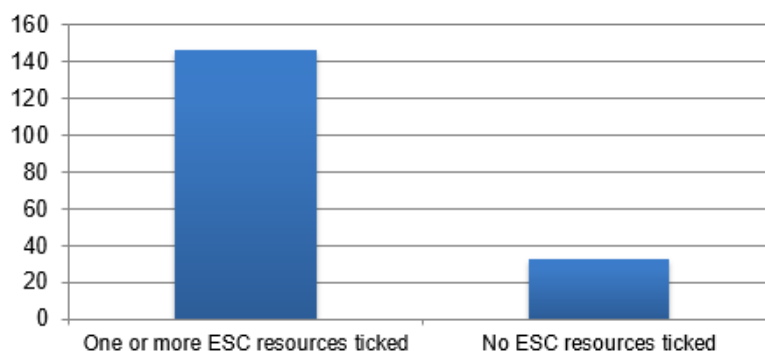


Figure 14: Trust in general

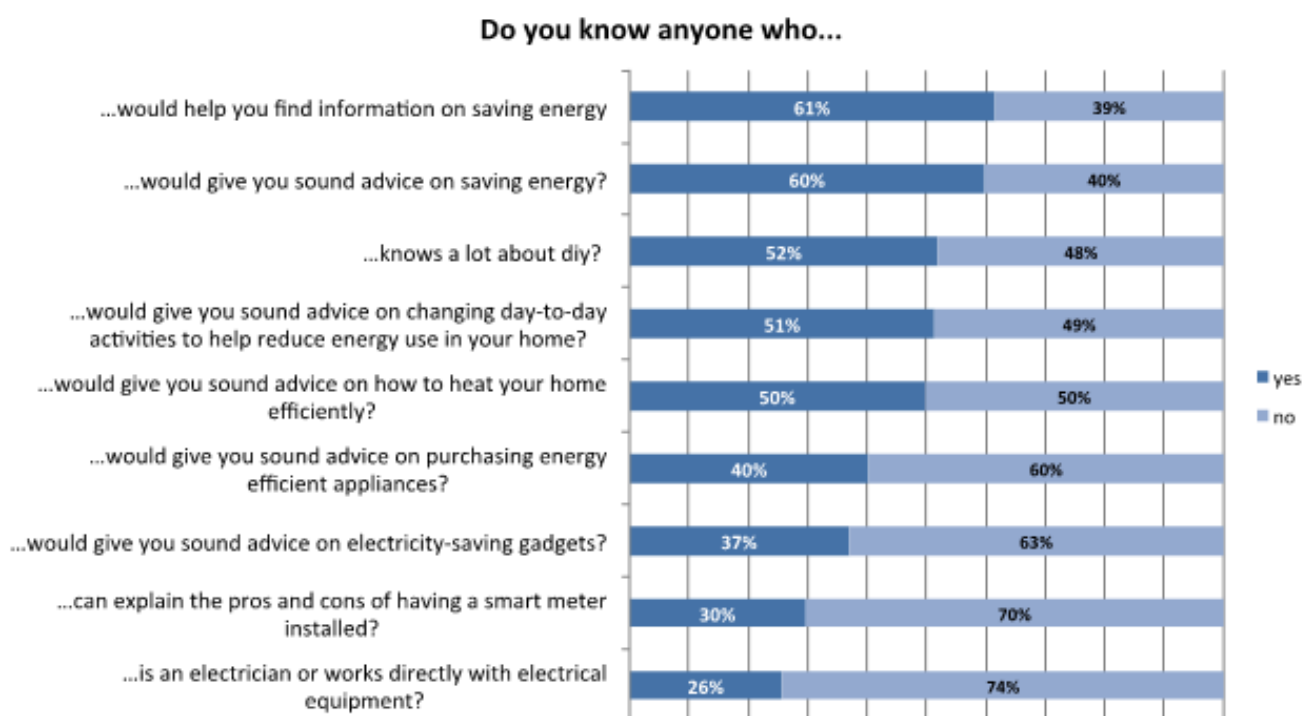
### Energy Social Capital Resources

Several questions addressed where people look for, or find, information on energy efficiency or household energy use. This addresses the form of social capital defined as the 'resources available in a person's network'. The more resources available, the more social capital a person is thought to hold; in this case, the more energy efficiency resources that a person holds, the more energy social capital that person is deemed to have. Previous research has linked this type of research with higher instances of adoption of energy efficiency devices (see McMichael, 2011 & McMichael & Shipworth, 2013<sup>14</sup>).



**Figure 15: People identified as ESC resources in social network**

Participants were asked whether they knew people who they could ask about a range of energy related issues. 18% (33) respondents left this question blank, or ticked no to every question, but 82% (146) were able to identify at least one person they knew to ask for information in one of the areas (see Figure 15).



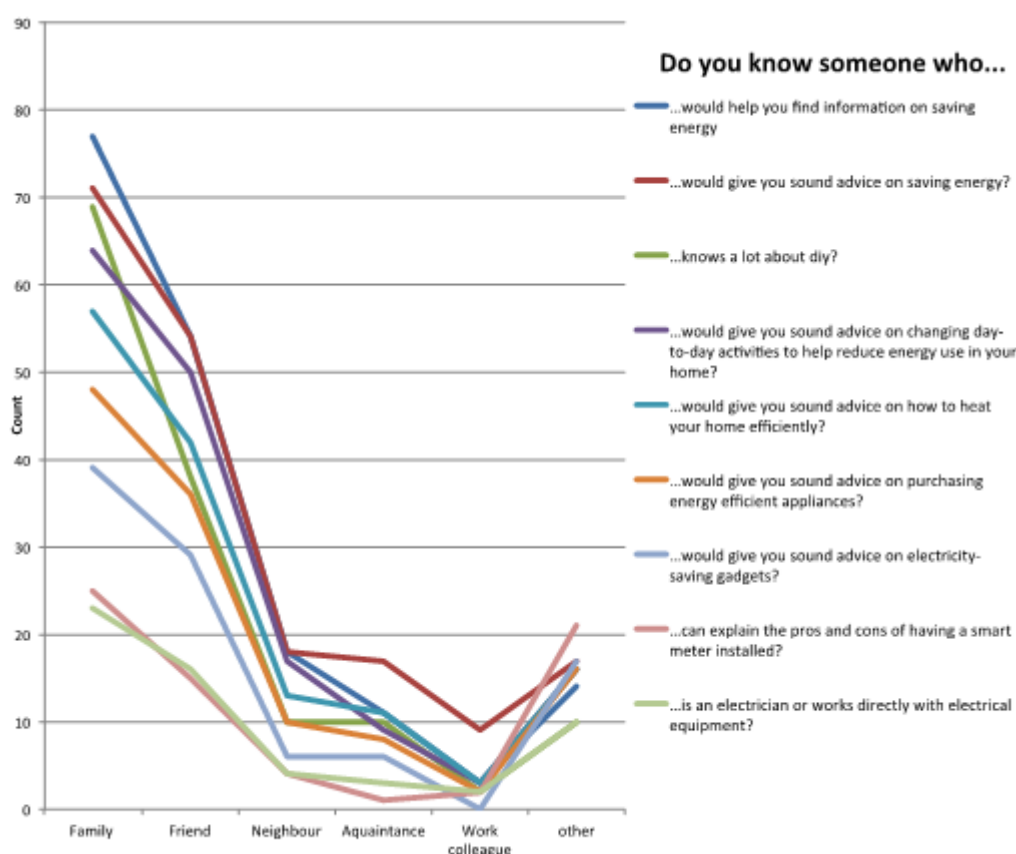
**Figure 16: Knowing people who can help with energy use in the home**

The highest positive responses related to knowing people who could help save energy; 61% (110) of respondents knew someone who could help them to find information on saving energy, and 60% (107) of respondents knew someone who would give them sound advice on saving energy (see Figure 16).

<sup>14</sup> McMichael, M. and D. Shipworth (2013) "The value of social networks in the diffusion of energy-efficiency innovations in UK households." Energy Policy 53: 159-168

Respondents were asked to specify whom within their social networks they could turn to for advice or information on energy use in the home. They could tick as many types of people out of 'Family, Friend, Neighbour, Workmate, Acquaintance or Other'. Figure 17 shows that the majority of energy social capital resources are within the family. Without exception family members made up the biggest group of people who could be asked about any issue, followed by friends.

Interestingly it is only in the case of learning about smart meters that a third category of person becomes an equally important source of information. 21 respondents identified 'Other' in response to this question, while family members were identified by 25 respondents and friends by only 17. This means that this population has fewer energy social capital resources for helping them understand smart meters may be further removed from their immediate social networks.

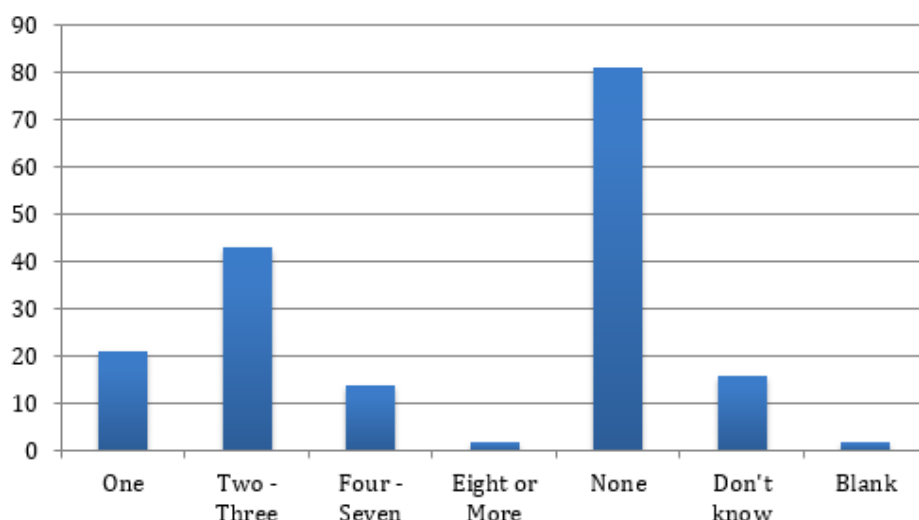


**Figure 17: Sources of help and advice on energy**

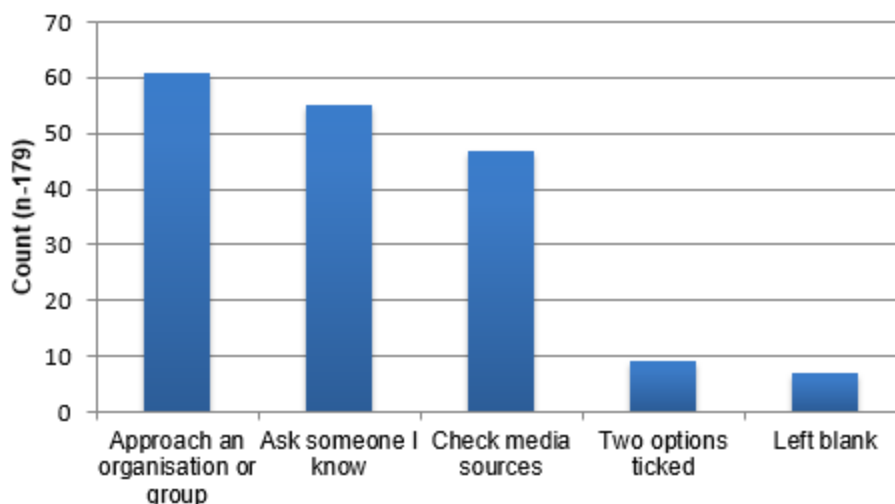
### Finding Information

The survey also identified how people 'operationalise' (or put in use) their ESC. Respondents were asked to think whether they'd discussed electricity with people they know in the past 6 months. 45% (80) had had a conversation with one or more people they know in the last 6 months about electricity, while 45% (81) had not spoken about electricity in the past 6 months (Figure 18). This suggests electricity is not a major source of concern or interest for the sampled population.





**Figure 18: Conversations about electricity in the past six months**

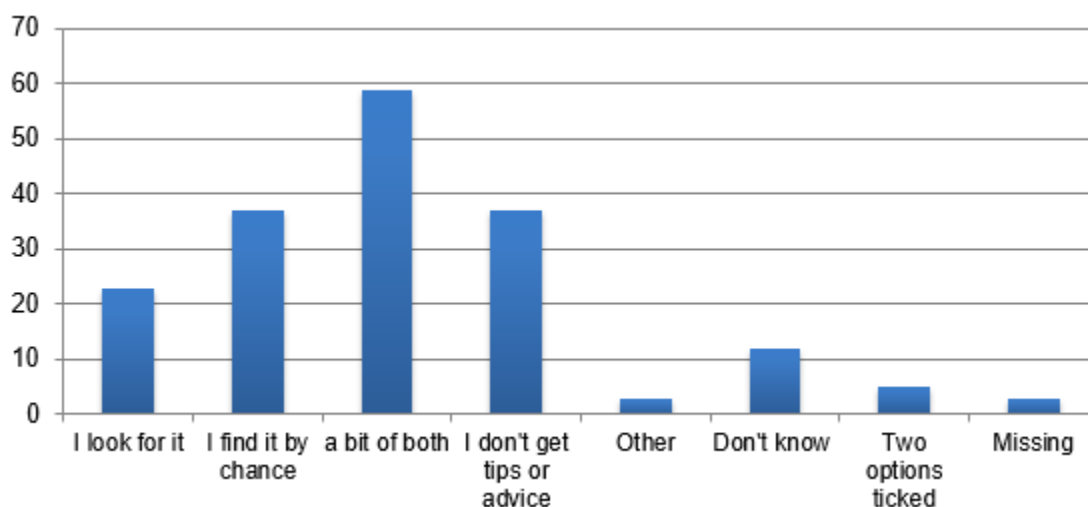


**Figure 19: The first people would go for information in the future**

Respondents were also asked what would be the first thing they would do if they had a question on electricity in their home, 34% (60) said they would ask someone they know, 29% (52) said they would check media sources and 37% (66) said they would approach an organisation or group (see Figure 19). This suggests that although this population recognise their family as a source of information and advice on energy, individual respondents are more likely to turn to resources outside of their social networks rather than turn to their family when looking for information.

Furthermore, when asked whether they actively sought information about electricity and energy efficiency, only 13% (23) respondents said they did, while 21% responded that they 'don't get tips or advice' (see Figure 20). 21% (37) respondents said they found information by chance, while 33% (59) felt they received information through a mix of chance and by actively searching for it (see Figure 20). This means that the majority of respondents are getting information or advice about electricity or energy efficiency, but only a minority are actively pursuing this information. This can be interpreted positively for the project because even when people receive information passively about electricity they still recognise this information source. Therefore, the introduction of a feedback device such as an in-home display connected to a smart meter may be recognised as a useful source of

information about managing electricity in the home, even though the participant has not actively been seeking this type of information.



**Figure 20: Active information seeking**

#### Energy Social Capital and primary language spoken at home

By compiling the data provided by participants for the HES, it is possible to understand how ESC varies according to the primary language spoken at home. University College London has received HES for 149 of the participants who returned their ESC survey. Of these, three chose not to provide their ethnic group, but only one chose not to answer the question about the primary language spoken at home. Therefore, language information correlated to ESC information is available for 148 of Trial 1 respondents.

In the results that follow these respondents are divided into four groups based on primary language; English (73 households), Bengali (54 households), Joint English & Bengali (14 households), and 'Other' which includes one Portuguese speaking household, one Chinese speaking household and five households which marked 'Other'.

#### Trust

This information shows that local levels of trust are higher for households who have Bengali as their primary language (Figure 21)

This distinction is not as large when looking at generalised levels of trust as shown in Figure 22 below.

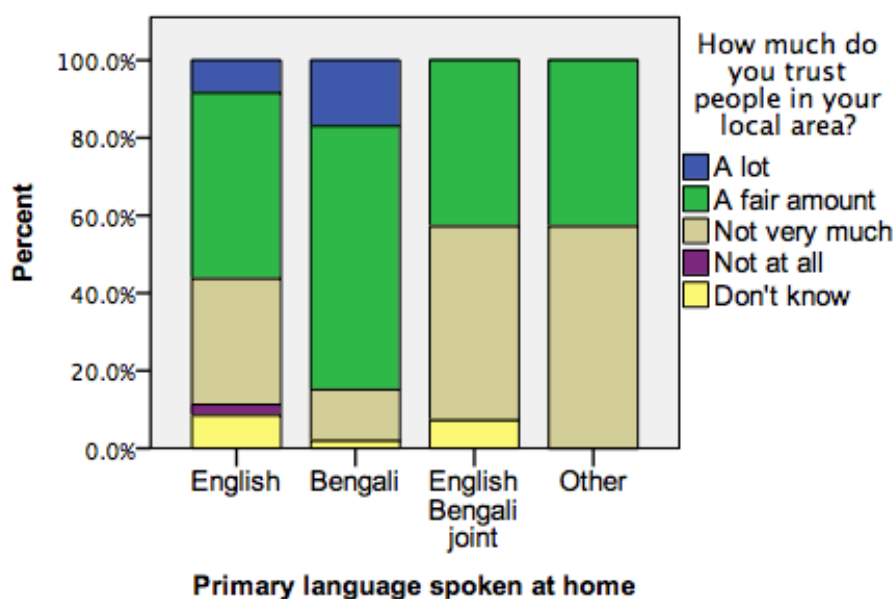


Figure 21: Local trust by language group

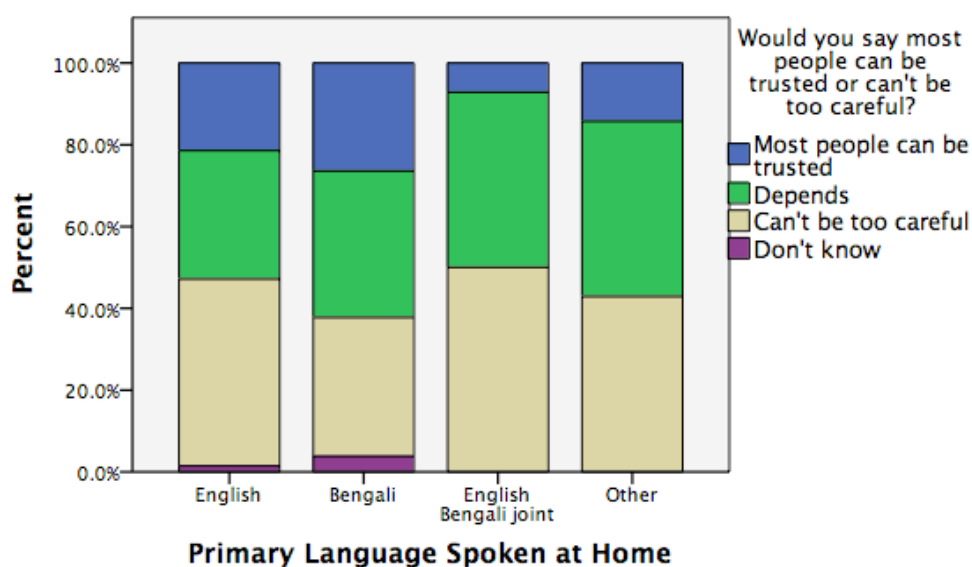
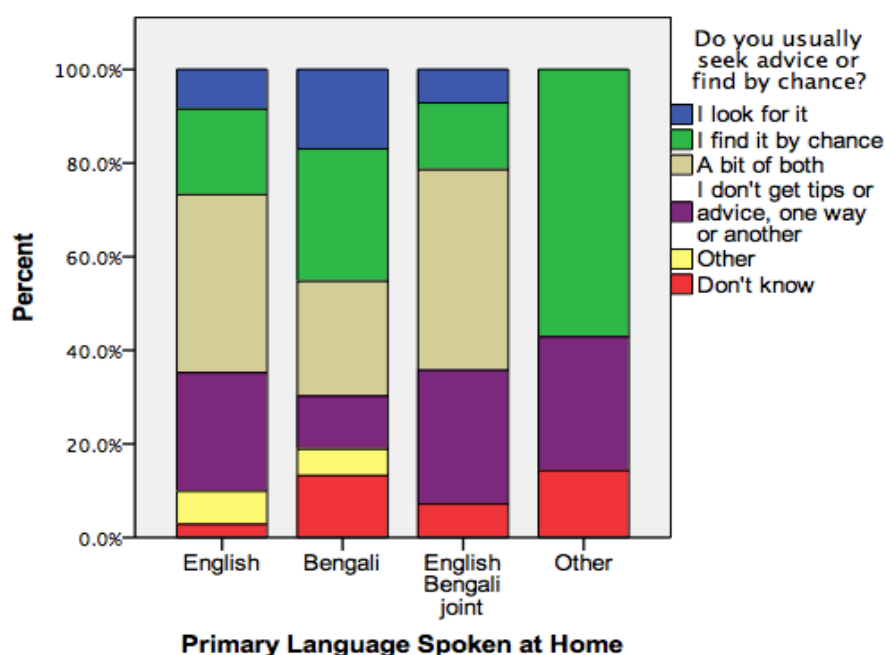


Figure 22: General trust by language group

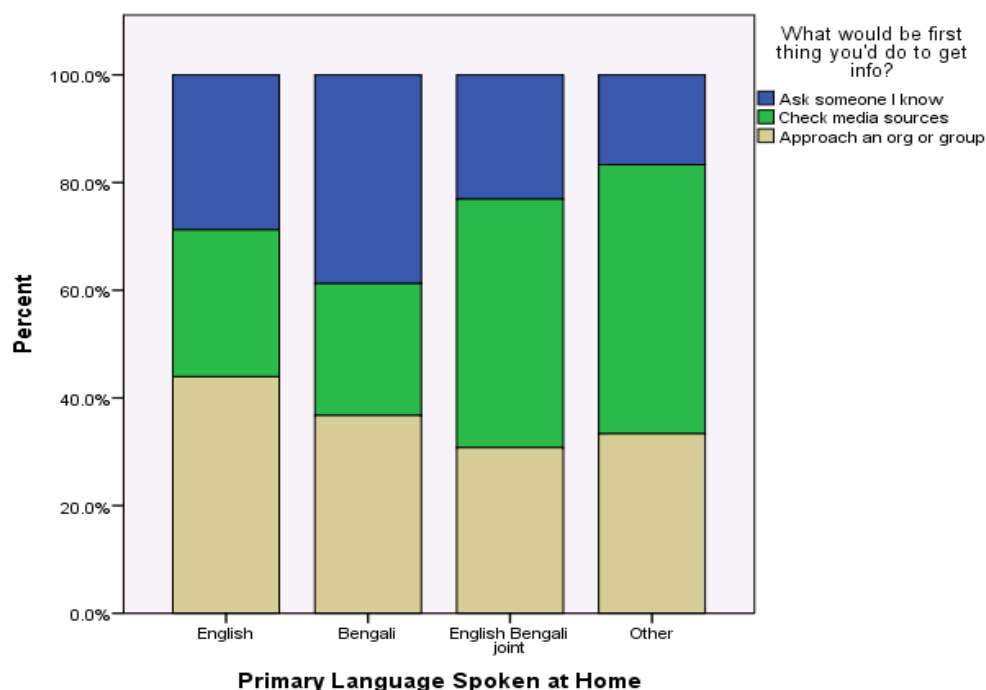
### Information seeking

Members of Bengali speaking households are more active in seeking information about electricity and energy advice. The overall split between those who receive information actively, passively and through a combination in comparison with those who feel they do not receive information is broadly similar across language groups, with between 66% and 57% feeling that they do get some information (Figure 23).



**Figure 23: Information seeking by language group**

The sources used to find information differ slightly with English language households more likely to approach an organisation, Bengali Language households more likely to ask someone they know and joint Bengali and English language households more likely to use the media (Figure 24).



**Figure 24: Information seeking by language group**



More analysis is needed to understand these variations particularly to examine the relationship between language group, household income and household demographic structure to establish if these explain some of the variation observed.

### Engaging with stakeholder organisations

Organisations and institutions can contribute to a household's ESC if they are recognised as trusted sources of relevant information. The research was designed to firstly identify local organisations that might fulfil this role and secondly to activate this form of ESC through a process of engagement. The stakeholder engagement process was designed to understand the local organisations that participants turn to for advice as well as to provide additional support for the project by ensuring the key project messages were circulated amongst local organisations.

As part of the trial design local organisations were identified and categorised to provide a ranked set of stakeholders that might be recognised as trusted sources of information by the research participants. The process of engaging these stakeholders was initiated prior to the recruitment phase of the trial, but was suspended as the recruitment process required the project team members to concentrate all resources on recruiting participants. The stakeholder engagement process was reinstated and completed following the recruitment phase.

The rationale for continuing with the process of stakeholder engagement beyond the planned pre-recruitment phase was that local organisations can continue to support the project if they are aware of the objectives and the outcomes for any participant involved. They can relay key messages and raise confidence in the project should participants turn to them to discuss concerns about their involvement.

In addition, through a process of ongoing engagement, stakeholders can provide a valuable feedback loop and may provide some insight into participant concerns and annoyances. This will help project partners to reflect on project processes and improve the research experience for participants, while also enabling the research team to gain more insight into how ESC functions within the trial population.

Following the decision to restart contact, the list of stakeholders was reviewed with Bromley Bow Centre staff and reprioritised using the criteria adopted in the original mapping exercise (expertise, willingness and value) but updated with new categories, reflecting Bromley by Bow Centre staff insight on the roles of the organisations. The contact process restarted on 17 November 2015. In total attempts were made to contact 22 organisations, but 13 were not contactable. Of those reached, two had heard of the project through word of mouth. They did not know any specific details and did not provide any feedback, but did show that there is at least a very low level of talk about the project.

When contacted, all organisations were given the key messages about the project and asked if they could be contacted again in the future. The seven organisations that agree to this can therefore be contacted at key stages in the project with an update, and to ask if any of their service users have discussed the **energywise** project. The next contact is planned to take place within the first three months of Trial 2. This will be an opportunity to provide key facts about the energy shifting trial and identify any feedback.

## 4 Trial 1

Trial 1 is the first of the two **energywise** trials conducted within Tower Hamlets and it focuses on energy saving. The aim of Trial 1 is to identify the magnitude of energy savings and the impact on the electricity network when customers have access to smart metering solutions, simple affordable energy saving devices and energy saving advice.

As described in Section 2.3, the trial has an intervention and a control group, with random allocation of participants between groups. A package of interventions (see Section 4.2) has been provided to an 'intervention group' against a 'control group' that does not have access to them, as per the requirements of a randomised control trial. Therefore, the effect of the trial will be quantified through comparing findings from the intervention group to the control group. Please note that 'control' group does not mean controlled to have similar level of consumption or household size, and similar criteria, as outlined in Section 5. As such, some adjustments are required when making the comparison.

### 4.1 Trial 1 overview

A 'feathered-in' approach was adopted for Trial 1: as opposed to having all trial participants entering into Trial 1 on the same date, the individual start date of Trial 1 is defined as the date of the first reading received from the monitoring equipment. This reflects the participants' experience, as it is the installation of the smart meter, and provision of the in-home display, that provides the participant with the capacity to learn about and respond to feedback on their energy use.

As shown in Figure 25, some households in the intervention group of Trial 1 started in May 2015 with the first installation being completed on 20 May 2015. Control group participants have generally started the trial from August onwards when a technical solution was determined to resolve the space constraint challenge of the secondary electricity meter installation in the meter cabinet.

The 'feathered-in' approach enabled further extension of the installation phase. With this approach the project will also be able to carry out a more accurate data analysis as it will analyse the electricity data from the installation date, therefore capturing the behavioural change expected immediately after installation in the intervention group. It is worth noting that this approach potentially introduces some seasonal variability effects: as the data capture period will be different for each household in the trial, certain months of the year will now be monitored in 2016 for some households while in 2017 for other households. It is worth noting that the prevailing weather conditions in those months may differ from year to year). However, the approach used for Trial 1 analyses (see Section 5.2) minimises any potential effects of different start dates and seasonal variability.

As each smart meter installation was completed during the setup of Trial 1, the monitoring of electricity usage started right away. Smart meters report daily (and half-hourly) to a central repository at British Gas. British Gas pass a cut of the available data to the analysis partners at University College London and Element Energy, on a regular basis. The analysis presented in the SDRC 9.3 report submitted in June 2016 was focusing on the first six months of the energy saving trial and specifically on the daily data received as of 31 January 2016. This report is an update to the SDRC 9.3 report and it covers the data analysis carried out on electricity and network data gathered over a 12-month period in Trial 1.

In January 2016, British Gas identified an error within the technical configuration of the head end system affecting half-hourly meter readings for 48% of the project's smart meter credit installations (see lesson learnt L7.4 in Section 9.7 for half-hourly meter reads). This issue was rectified in February 2016 with the half-hourly data from credit smart meters being successfully returned to the read repository since then. While this has no impact on the assessment of the energy saving analysis that is based on daily reads, it has an impact on the network modelling and benefit assessment for the Trial 1 winter period. To complete the 12-months of data capture of credit customers' half-hourly data and carry out the associated network modelling, Trial 1 was therefore extended until 14 February 2017.

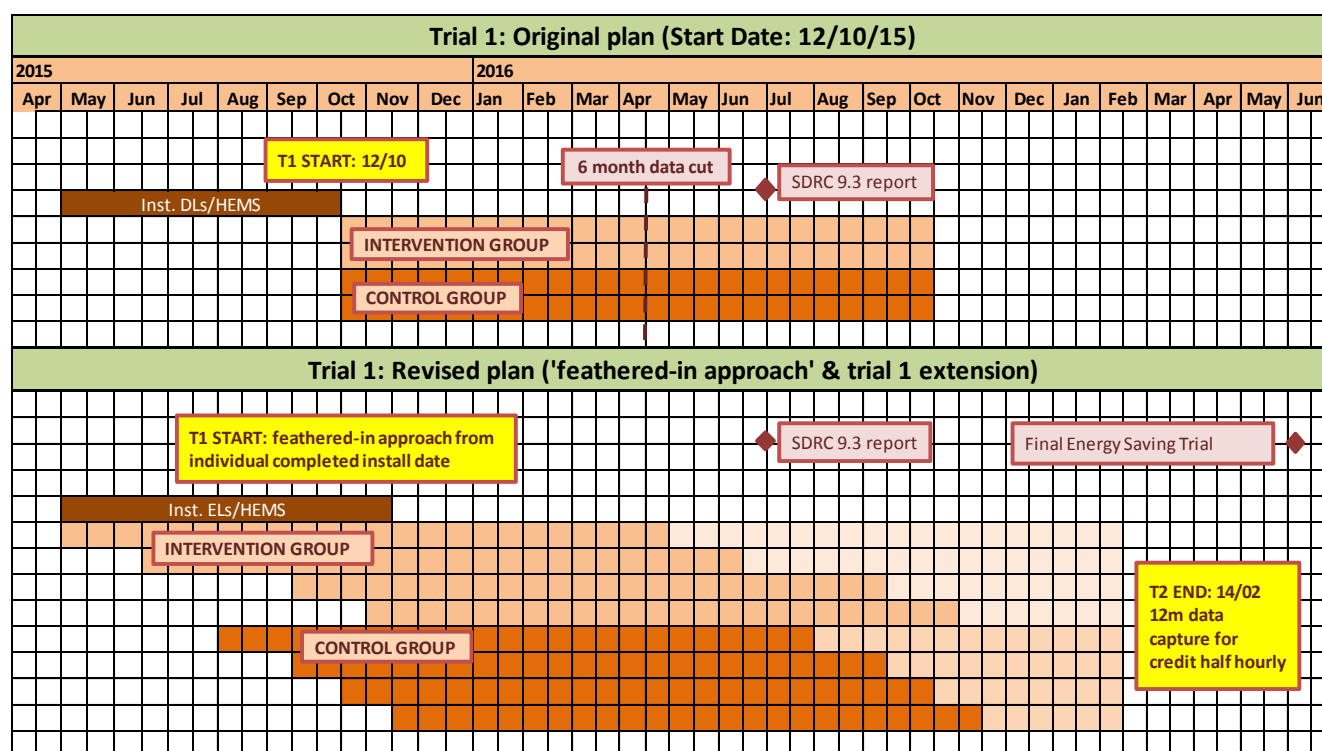


Figure 25: Trial 1 plan

A similar defect affected all 65 smart prepayment meters installed in the project, which equates to 52% of the project's total prepayment meter population (see lesson learnt L7.4 in Section 9.7 for half-hourly meter reads). Following an investigation with British Gas' meter manufacturer and the head end service provider, the root cause has been identified and a solution successfully developed. This solution was delivered at the end of 2016 and now allows transfer of half-hourly consumption data along with the daily consumption data from **energywise** participants equipped with prepayment smart meters. As the historical data cannot be recovered, the half-hourly data of customers with smart prepayment meters are missing for Trial 1. The daily smart meter reads are available and are considered in the analysis within Section 5.3.

As such, the analysis presented in this report is focused on the following:

- The **energy saving analysis** is based on daily reads and is carried out over the first 12 months of Trial 1. For each participant, the first 365 days are taken into account, starting at their individual installation date;
- The **network modelling** is based on half-hourly reads and is carried out on the 12 months where the fulfilment of credit half-hourly data is highest, i.e. from 15 February 2016 to 14 February 2017.

Using this approach makes best use of the daily consumption and half-hourly data available and maximises the insights that can be identified in each case.

## 4.2 Trial 1 interventions

Trial 1 interventions have been provided to active participants during the installation phase of the project depending on their group allocation as per to the research trial design presented in the SDRC 9.1 report.

The project began installations at the end of May 2015 at households who had signed up within the pilot study and the installation work was then continued with main trial participants. An issue was identified where several technical aborts were registered within control group due to space constraints for the installation of the secondary electricity meter in the meter cabinet: in fact, for control group households within building category B (the building

type which the majority of the projects' eligible households reside within), the meter cabinet containing the current meter and consumer unit had insufficient space for the secondary electricity meter to be mounted. Two different solutions have been implemented depending on the meter type:

- **Credit customers in control group:** a credit smart meter was installed (including a gas smart meter for dual fuel customers) but the smart energy display was not commissioned; the smart meter would simply work as electricity monitoring equipment, while no customer engagement will be 'activated' until Trial 2 when the smart energy display will be delivered to control group participants.
- **Prepayment customers in control group:** as some key prepayment functionalities are not accessible for prepayment customers if a prepayment smart meter is installed without the smart energy display, a different solution has been implemented for prepayment customers in the control group. This is in the form of a device called Navetas electric loop, being installed by the British Gas subcontractor Passiv Systems (as confirmed on 11 September 2015). As an electric loop consists of a clamp connected to the standard meter and does not require additional secondary units to be installed in the meter cabinet, this technical solution was proven to be successful in the resolution of any space challenge (See Figure 26).



**Figure 26: Navetas electric loop equipment**

Table 3 provides an overview of the interventions of Trial 1: the intervention package provided during the installation phase included mainly the smart metering solution with the smart energy display, the British Gas Smart Energy Expert's installation visit including the British Gas energy efficiency booklet, the energy saving devices delivered by the CFO and the energy efficiency advice leaflet developed by the project (Figure 27).

The research design envisaged that the energy efficiency devices and the energy efficiency advice leaflet would be delivered during the smart meter installation. However, it was not always possible for the CFO team to visit the property at the same time as the Smart Energy Expert. Therefore, the devices and leaflet were often delivered at a different time and required an extra appointment to be arranged with the household.



**Figure 27: Energy efficiency devices & energy efficiency advice leaflet**



**Table 3: Overview of interventions and non-interventions provided in Trial 1 to intervention and control group**

Interventions	Trial 1			
	Intervention group (group 1)		Control group (group 2)	
	Credit	Prepayment	Credit	Prepayment
Electricity smart meter	Credit smart	PP smart	See below	-
Gas smart meter	Credit smart <sup>15</sup>	PP smart <sup>15</sup>	See below	-
Smart energy displays	Credit smart	PP smart	-	-
British Gas Smart Energy Expert	Yes	Yes	See below	-
Energy efficiency booklet	Yes	Yes	-	-
Energy saving devices (three LED lightbulbs, one eco-kettle and one standby shutdown)	Yes	Yes	-	-
Energy shifting devices	N/A	N/A	N/A	N/A
Advice on energy efficiency & energy saving devices	Yes	Yes	-	-
CFO electricity efficiency advice	Yes	Yes	<sup>16</sup>	<sup>16</sup>
Newsletters	Yes (Not yet)	Yes (Not yet)	-	-
Stakeholder support	Yes	Yes	-	-
Dissemination events <sup>17</sup>	Yes (Not yet)	Yes (Not yet)	-	-
<b>Non-interventions</b>				
Referrals by CFO to further information	Yes	Yes	Yes	Yes
Temperature monitoring equipment	Yes	Yes	Yes	Yes
Electricity smart meter (without smart energy display)	-	-	Yes (apart from 2 households)	-
Gas smart meter (without smart energy display)	-	-	Yes <sup>18</sup> (apart from 2 households)	-
Passiv ICM 300 secondary meter	-	-	2 households only	-
Navetas loop monitor	-	-	-	Yes
British Gas Smart Energy Expert	-	-	Only as installer	-

<sup>15</sup> Gas smart meters only constitute part of the trial due to the business as usual smart meter rollout at dual-fuel customers who will receive both an electric and gas smart meter as part of the standard customer journey. It is envisaged that this strategy will have positive effects related to the replication point of view. Please note, 8 households in intervention group (2 credit and 6 prepayment customers) have only electricity supplied by British Gas, therefore they did not receive a gas smart meter installation.

<sup>16</sup> Please note, if a control group participant asks for energy efficiency advice, the CFO will refer them to standard sources of energy efficiency information.

<sup>17</sup> In addition to dissemination events, some participants will attend participant panels. These are not considered part of the intervention in the trial, as it is not envisaged that they will apply to all participants or would be replicated by other DNOs under the replication model.

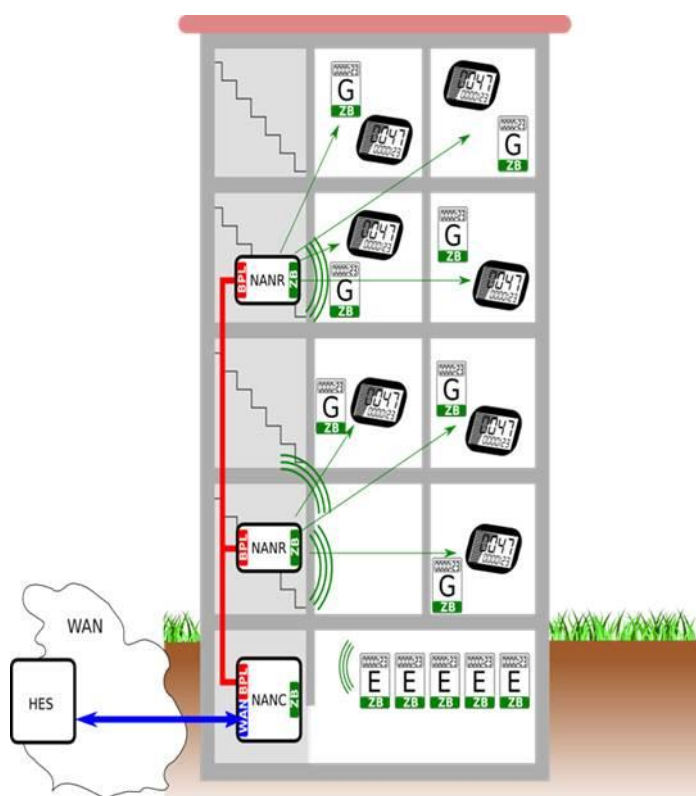
<sup>18</sup> Please note, 2 households in control group (both credit customers) have only electricity supplied by British Gas, therefore they did not receive a gas smart meter installation.

All installations for the control group as well as installations of the standard smart metering solution for the intervention group (apart from those in Padstow House) were completed by PassivSystems by 5 November and by British gas by 23 November 2015, while the delivery of the energy efficiency devices was completed by 25 January 2016 (apart from those in Padstow House and one outstanding household that has not received the three LED light bulbs yet due to the customer being unreachable).

Installations in Padstow House (see Figure 28) were completed on 19 May 2016 following the installation of the MDU Communication Backbone supplied by Siemens in the preceding days. Once the installation by Siemens was complete, smart meters with Smart Energy Displays and the temperature monitoring equipment have been installed by British Gas and PassivSystems respectively on 19 May. During the home visit the customer field officer has delivered all four sets of energy efficiency devices together with the energy efficiency advice leaflet and has administered the four home energy surveys, of which two were completed at that time and two were left for self-completion following the customer's request.



**Figure 28: Padstow House**



**Figure 29: MDU communications backbone**

Out of the four households that received their equipment in May, two required the MDU infrastructure to be able to benefit from the smart metering solution. Both meter sets were fully commissioned and communicating with the Smart Home Display in operation in the customers' homes. All meters are returning both daily and half-hourly readings. The innovative MDU Communication Backbone (see Figure 29) supplied by Siemens for tall and difficult building was therefore proven successful with both smart meters operating on the extended HAN network, resulting in the UK's first end to end installation of residential smart meter sets operating across a Multi Dwelling Unit/tall and difficult building solution.

Given the differences between installation dates and delivery dates of the energy efficiency devices and energy efficiency advice leaflet, the project partners agreed to use the date of the first smart meter readings coming through as the start date for each individual household. This is because, from the participant's perspective, the receipt of the smart energy display and the interaction with the British Gas Smart Energy Expert constitutes

what is likely to be the single largest intervention in energy savings terms.

## 5 Customer insights

### 5.1 Electricity data

#### 5.1.1 An introduction to the electricity data (daily and half-hourly data)

As noted in Section 4.2, British Gas installed smart meters into credit and prepayment intervention group customer properties, and credit smart meters into credit control group customer properties. Intervention group customers received a full smart metering installation including smart energy display with meters configured to return daily and half-hourly meter readings each day. Credit control group customers received a smart meter installation without any smart energy display but with the meter configured to return daily and half-hourly meter readings each day. The energy consumption for prepayment control group customers is collected via the Navetas loop monitoring equipment, as the project was unable to install prepayment smart meters without a smart energy display. The loop monitoring equipment is also configured to return half-hourly readings intervals.

When the meter is able to return the daily and half-hourly data, this data is stored in the British Gas reading repository. From here, on the fifth day of each month, to allow for delayed/missing readings to be returned, the data for the previous month is extracted from the read repository. These readings are then processed using the “Check Supplier Data” process outlined in Section 5.1.2. From here the daily and half-hourly monthly reading files are zipped, encrypted, and sent to University College London via the secure files transfer systems for project analysis. The consumption data for loop monitoring equipment is supplied to British Gas by Navetas on the fifth of each month. Navetas use a secure internet gateway that connects the loop monitoring equipment to a secure web platform. The energy consumption data from the loop monitoring equipment is transferred to this platform via a broadband or GSM internet connection. British Gas then run the “Check Supplier Data” process and transfer the files to University College London using the agreed secure project data transfer methods outlined above.

#### 5.1.2 Data quality and data accuracy checks

##### British Gas Check Supplier Data processes

There is a ‘Check Supplier Data’ process set up for British Gas to run pre-checks, data cleansing, and validation on the smart meter and temperature monitoring reading data supplied to University College London as there may otherwise be a delay until University College London identifies any data issues.

The first step of the check supplier data process is data cleansing. British Gas ensure there are no duplicate readings contained within the data sets and that the most recent and fulfilled data sets are supplied (deleting others). The data is then validated at a household level (i.e. data quality is assessed for each household individually) and fulfilment reports are created for each data file, each month, detailing the data start date, data end date, and data fulfilment in number of days and percentages.

##### University College London Data Quality/Quality Assurance processes

A key objective of the quality assurance process for **energywise** data is to ensure that both the quantity and quality of data available for analyses is maximised. Both quantity and quality of data are important as they have substantial effect on the level of statistical confidence in findings. Table 4 summarises the electricity data available for the 12-month data analysis presented in this report.

**Table 4: Summary of electricity data**

Meter type	Readings	Available data as of 28 February 2017
<b>Smart meter</b>	Daily Reads	<ul style="list-style-type: none"> <li>University College London have received smart meter data (daily reads) for 284 participants</li> <li>After dropouts (participants who chose to withdraw from the project), and one faulty meter, 241 meters were providing daily readings for potential inclusion in this report.</li> <li>University College London have received 124,484 valid daily read records from active participants</li> <li>The fulfilment rate (valid daily reads received/possible daily reads) for active participants with data is approximately 92%</li> </ul>
	Half-Hourly Reads	<ul style="list-style-type: none"> <li>Due to issues with the installation of some smart meters (see Section 9.7 for more detail), prior to February 2016 University College London had received half-hourly data for only 90 participants</li> <li>In February 2016 a fix was applied which resulted in half-hourly data being received from 186 active participants (with 182 participants still active in Feb 2017).</li> <li>University College London have received 3,974,595 half-hourly read records from active participants.</li> <li>The fulfilment rate (HH reads received/possible HH reads) is approximately 95%</li> </ul>
<b>Navetas electric loops</b>	Quarter-Hourly Reads	<ul style="list-style-type: none"> <li>Approximately 45 participants (prepayment customers in the control group) have their electricity consumption recorded by Navetas Loop Sensors</li> <li>After dropouts (participants who chose to withdraw from the project), 30 participants were eligible for potential inclusion in this report.</li> </ul>

The installation of smart meters was staggered from May to November 2015 with a low number of installations in the early months skewed towards the intervention group. The First Read date represents the date that the smart meter was fully up and running (commissioned) and the first point at which analyses of electricity consumption can begin. Table 5 shows the number of participants whose smart meters were commissioned (became “active”) by month.

**Table 5: Number of participants whose smart meters were commissioned (became “active”) by month**

Month	First Reads	Cumulative
May	10	10
June	19	29
July	74	103
August	39	142
September	80	222
October	56	278
November	6	284
<b>Total</b>	<b>284</b>	



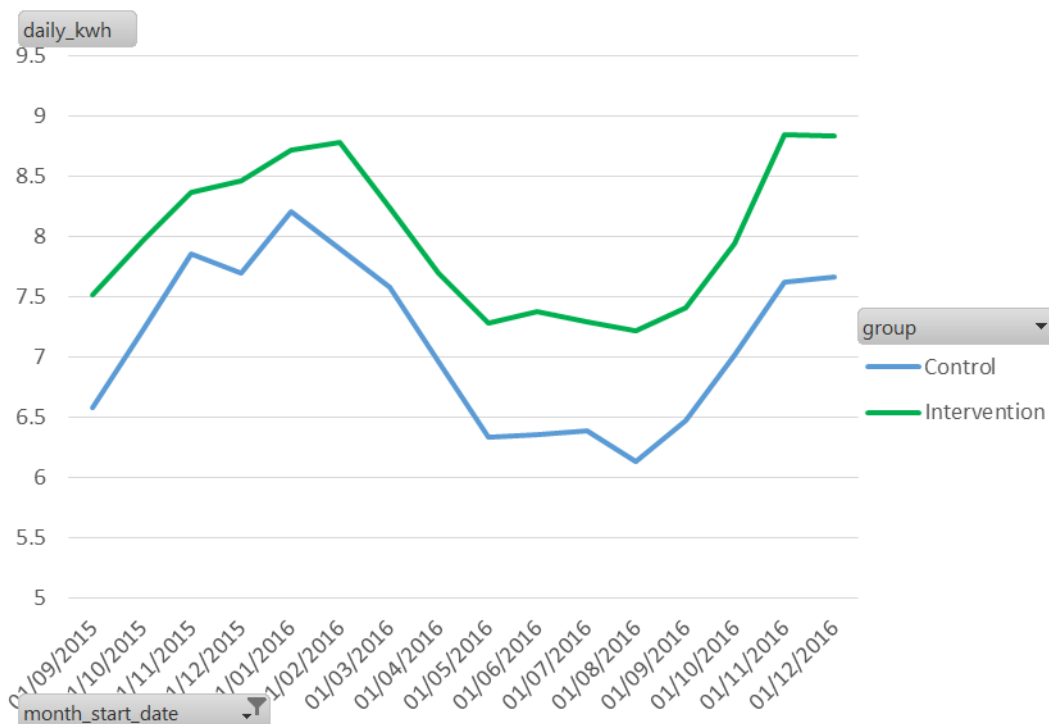
The University College London data quality processes applied to the data for this report include basic checks to ensure that files match relevant data specifications, checks for duplicate records, checks for missing data, tests on the distribution of missing data, checks for erroneous or suspect values (e.g. extreme outliers), tests for suspected meter faults, and the creation of various data quality variables.

## 5.2 Quantitative analysis

Analyses of electricity consumption is the primary method for investigating any energy saving resulting from Trial 1 interventions. Electricity consumption in the intervention group was compared to consumption in the control group (who did not receive the intervention measures) to calculate energy savings.

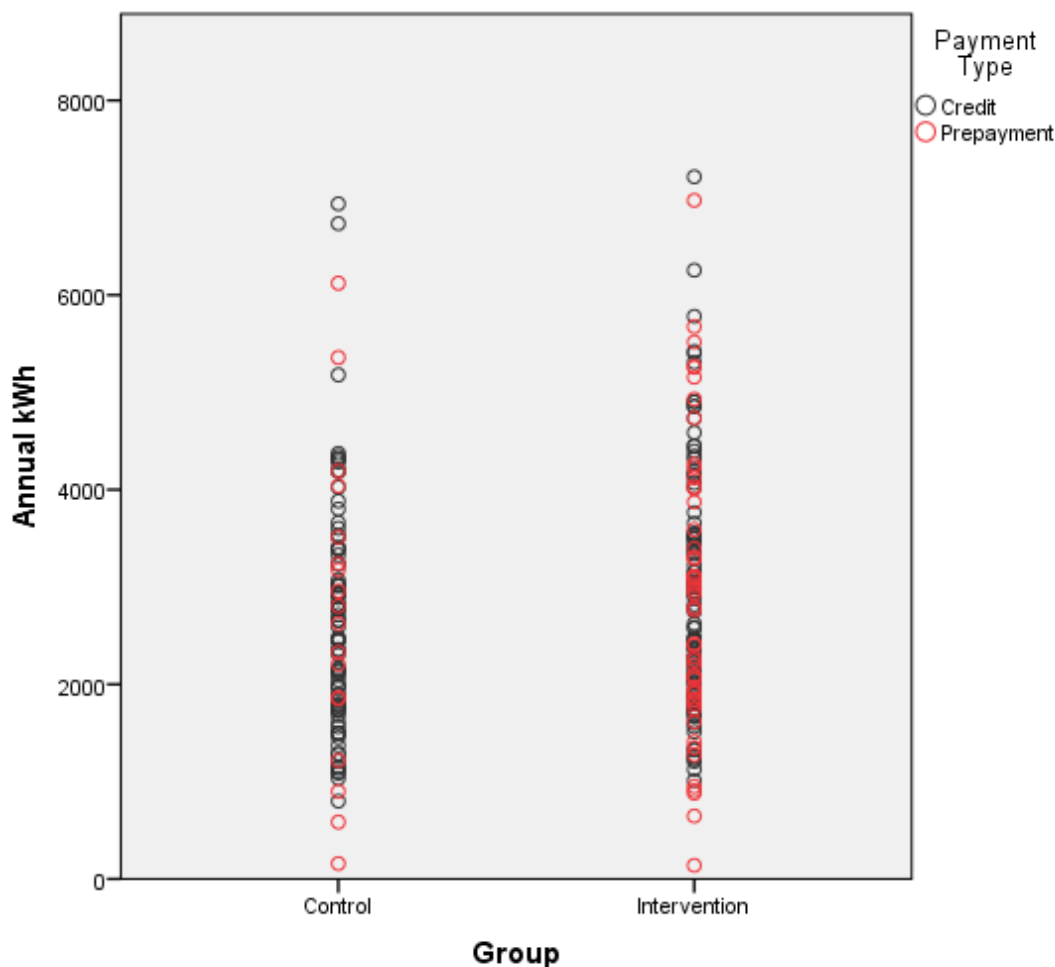
Figure 30 highlights that the intervention group has higher pre-trial electricity consumption (EAC) as well as in-trial consumption (daily kWh) that continues over the course of Trial 1. The higher consumption found in the intervention group could be due to a number of factors including household size, appliance ownership and usage, income etc. However, the difference in electricity consumption (whatever the cause) between the two groups can be accounted for by using a 'difference in difference' approach to the analyses (see Section 5.2.1)

Figure 30 also shows that the intervention and control groups have largely parallel trends that reflect the seasonal/weather impact on energy consumption i.e. electricity consumption rises during colder, darker winter months and falls during summer months. Parallel trends are an additional factor that make Trial 1 analyses a good candidate for a 'difference in difference' approach presented below.



**Figure 30: Average Daily kWh by month, Credit customers**

Figure 31 (below) highlights the different distribution of annual consumption between the two groups with the intervention group having substantially more participants with > 4,500 kWh than the control group.



**Figure 31: Scatter plot showing Trial 1 annual electricity consumption in kWh (Annual kWh Adjusted) by Group and Payment Type.**

The following challenges for Trial 1 energy saving analysis have been identified:

1. Participants did NOT start the trial at the same time – the installation of smart meters (the main intervention) took place between May and November 2015.
2. The intervention group starts and continues with a higher energy consumption than the control group (approx. 10%)
3. There are different processes for pre-intervention and post-intervention measurement of electricity consumption. This is because the main intervention (smart meter) is also the measurement device.
  - a. Pre-intervention consumption is produced by the industry standard Estimated Annual Consumption (EAC) methodology. The EAC process adjusts for several factors (including a seasonal adjustment) to correct for different times of year when meter readings (or estimates) take place.
  - b. Post-intervention consumption is measured by the smart meter on a daily and half-hourly resolution. Therefore no adjustments are needed (as per the EAC process).

### 5.2.1 Difference in Difference Methodology

A 'difference in difference' (DID) methodology was chosen because it is a well-established methodology for assessing the impact of an intervention between groups and over time, and it fits with several factors affecting

Trial 1 (e.g. different average consumption between the groups but parallel trends in consumption over time). This methodology has also been used in other similar trials e.g. the Smart Meter Early Learning Project and the LCNF SAVE project.

The 'difference in difference' method is designed for use where the two groups being compared do not have to have the same starting values (i.e. they are different to start with). What the method assesses is whether, at the end of the trial, the difference between them at the start has changed over time. Hence it looks at the difference (i.e. change) in the initial difference between the two groups – hence the name. This is the case in **energywise** Trial 1 where the two groups have different starting values.

Another important benefit of the approach is that it doesn't matter if the measurement instrument changes between the start and the end of the trial as the approach calculates the differences between the groups as measured by the same instrument. In the **energywise** trial, the first measurement (before the intervention) was done with conventional meters and the Estimated Annual Consumption (EAC) data provided by British Gas. The second measurement was done using the more accurate smart meter data. The fact that the smart meters are more accurate doesn't matter in difference in difference analysis as it is the difference between the two group's energy consumption before and after the invention that is being compared. As both groups received smart meters, the change in accuracy of the measurement device (smart meters) will be balanced across the two groups and so will not skew results. The only exception to this is where pre-payment customers in the control group were not able to have smart meters installed and thus a different device to measure energy consumption was used. The potential impact on results for pre-payment participants is discussed at the end of section 5.2.2.

Finally, by using a whole year's worth of data for each home, any issues relating to the differences in the starting times of the various participants are negated. Because energy consumption is seasonal, taking a whole year brings the variation in consumption full-circle, and avoids biasing the data by missing out a part of the year that may be either higher in consumption (Winter), or lower in consumption (Summer).

Using the difference in difference approach therefore addresses the three main analytical challenges of the project, and does so in a comparatively simple way. Using this method, and applying Tukey's method of screening outliers (discussed below), the analysis finds an annual saving of 3.3% in Trial 1 (including both meter types), which is statistically significant at the level set out in the project proposal. The calculation equation:

Ratio =

$$\frac{\Sigma (\text{Annual in-trial consumption intervention group}) / \Sigma (\text{Annual pre-trial consumption intervention group})}{\Sigma (\text{Annual in-trial consumption control group}) / \Sigma (\text{Annual pre-trial consumption control group})}$$

A standard transformation from ratio to percentage change is then applied (i.e. 1 minus the ratio, multiplied by 100).

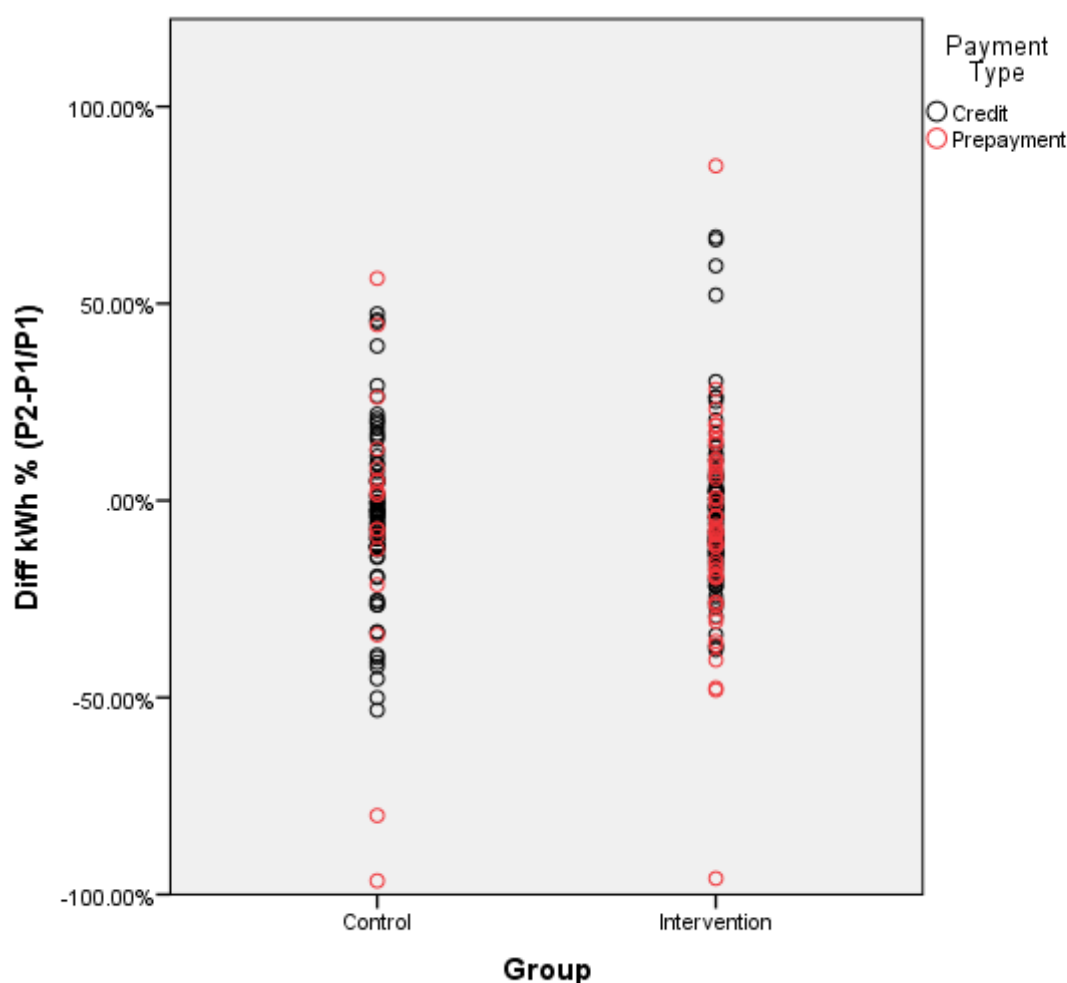
### **energywise DID methodology details**

The following notes explain the how the inputs to the difference in difference equation above were derived.

- Pre-trial consumption – Estimated Annual Consumption in kWh. While not perfect, this is the best estimate of the annual consumption for the 12 months prior to the start of Trial 1.
- In-trial consumption – Trial 1 (Adjusted) Annual Consumption in kWh. This is calculated as trial start date + 365 days. As participants started the trial at different times (mostly between June and October 2015) due to the logistics of the smart meter installation schedule, this is calculated for each participant. A straightforward linear adjustment is applied for meters that do not have a full 365 days of data. This adjusts the consumption to the full 365 day period using the formula:  $[\text{kwh\_in\_period}] + ([\text{days\_to\_full\_year}] * [\text{avg\_daily\_kwh}])$
- Participants with an EAC value of less than 1,000 kWh were excluded from the analyses. This is to minimise any skew resulting from households with very low energy consumption and to minimise

an effect of the EAC methodology which pushed results closer to zero when more estimated (rather than actual) meter readings are used.

- Households for which a pre-trial EAC value is not reported are excluded from the DiD analysis.
- Participants who have valid data for less than 305 days are excluded.
- Any data which has failed standard data quality checks (e.g. duplicate records, faulty meter readings etc.) has been excluded (or corrected, where applicable).
- Outliers have been excluded. This is described in more detail below.
- Participants in the control group who had prepayment meters could not be provided with a smart meter. Instead they were provided with an alternative energy consumption monitor. This monitor proved to be less reliable than smart meters and thus the useable data set for the prepayment control group is approximately 15 participants compared to approximately 50 participants in the prepayment intervention group. Any interpretation of results must be mindful of this context.



**Figure 32: Scatter plot showing the difference (%) in electricity consumption (Pre-trial vs In-trial) by Group and Payment Type**

Figure 32 shows the distribution of pre-trial vs in-trial change in electricity consumption between the two groups. The difference in electricity consumption is expressed as a % change of in-trial consumption compared to pre-trial (EAC) consumption.

Note that this chart highlights the impact of **outliers** with the control group having a greater number of participants who have reduced their energy consumption by more than 50% (bottom left) while the intervention group has a greater number of participants who have increased their energy consumption by more than 50% (top right). Outliers can skew results (whether included or excluded) and thus the approach to handling outliers can have a substantial impact on results.

### 5.2.2 Difference in Difference (DiD) Analysis Results

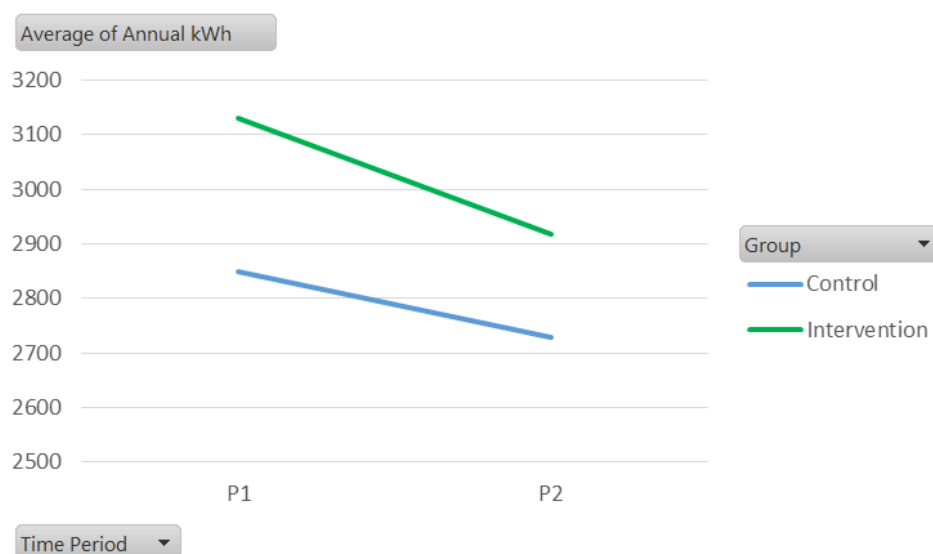
As with most statistical analysis, a 'difference in difference' methodology is sensitive to the approach to handling outliers. The most appropriate approach for handling outliers in the **energywise** Trial 1 analyses is Tukey's method which removes outliers outside the top and bottom of the Inter Quartile Range (IQR) x 1.5 IQR. Tukey's method is widely used for outlier filtering in the energy field because of the asymmetry of the distributions and the substantial difference between the mean and median of the population. In this context outlier screening based on assumptions of distribution symmetry is inappropriate.

Outliers can potentially skew results whether they are excluded or included. The treatment of outliers is a subject not without controversy, with strong opinions on both sides. There is no universal correct approach to handling outliers and thus it is a generally a decision made on a case by case basis. There are scientific and statistical reasons to include/exclude outliers:

- Statistical reasons – outliers can have a disproportionate effect on results. This is a by-product of the way the formula calculates the results – not because those participants whose energy lies further from the mean are somehow more important than those who do not. There is also an increased likelihood that the values of outliers arise from errors of measurement. For these reasons, it is standard scientific practice to remove outliers from analysis.
- Scientific reasons – the outliers that show large increases or decreases in energy consumption during Trial 1 are not a credible effect of the intervention being investigated. i.e. this trial shows a 3.3% average reduction in energy saving due to the impact of the Smart Energy Display and other Trial 1 interventions (which is in line with results from other previous trials) so a change in energy consumption of +/- 50% is highly likely to be caused by other factors (change in household demographics, exogenous energy efficiency interventions, etc.).

If included in the analysis, the impact of the outliers seen in Figure 32 would be to move the data point for the intervention group up at Period 2 (P2), and the control group down at P2 in Figure 32. This would then skew the results to reduce apparent energy savings arising from the trial.





**Figure 33: Line graph showing the pre-trial (P1) and in-trial (P2) annual electricity consumption (kWh) by Group (outliers excluded)**

Figure 33 shows that both groups reduced their energy consumption during the trial when compared to their pre-trial EAC consumption. This aligns with the UK trend over the previous decade of year on year reduction in domestic energy consumption. However, the relative gradient of the lines clearly show that the intervention group has reduced electricity consumption more than control group (see below for details).

The DID analyses results below have been provided separately for All (payment types), Credit and Prepayment participants. This is because of potential issues with the analysis of prepayment participants (discussed further below).

The calculation of outliers is done separately for each set of results, so the results for All cannot be derived by a simple aggregation of Credit and Prepayment results. The approach and variables used for calculating outliers is consistent across the analyses but the values (or threshold) for outliers will be different as the Inter-Quartile Range will be different for each set of results. Tukey's (IQR \* 1.5) method was applied which excludes outliers using the variable "Diff %" (percentage change of in-trial energy consumption compared to pre-trial consumption).

#### All Payment Types

Outliers were excluded using the variable "Diff %" where they fell outside the range of -41% to 32%

Group	N	Hhold Size	P1 (EAC)	P2 (Annual kWh)	Diff kWh (P2-P1)	Diff % (P2-P1) / P1	Diff Ratio (P2/P1)	DiD %
	Count	Mean	Mean	Mean	Mean	Mean	Mean	
Intervention	150	3.7	3128	2903	-225	-7.2%	0.93	
Control	92	3.9	2947	2828	-119	-4.0%	0.96	
<b>DID</b>	<b>242</b>						<b>0.97</b>	<b>3.3%</b>

N = number of households included in the analysis.

This analysis showed that the intervention group showed an energy saving of 3.3% when compared to the control group over the course of Trial 1.

These results are statistically significant using the **energywise** threshold of 0.25. P-value of "Diff Ratio" = 0.217

### Payment Type – Credit

Outliers were excluded using the variable “Diff %” where they fell outside the range -38% to 30%

Group	N	Hhold Size	P1 (EAC)	P2 (Annual kWh)	Diff kWh (P2-P1)	Diff % (P2-P1) / P1	Diff Ratio (P2/P1)	DiD %
	Count	Mean	Mean	Mean	Mean	Mean	Mean	
Intervention	99	4.2	3068	2826	-242	-7.9%	0.92	
Control	76	3.9	2871	2779	-92	-3.2%	0.97	
<b>DID</b>	<b>175</b>						<b>0.95</b>	<b>4.8%</b>

N = number of credit metered households included in the analysis

This analysis showed that the intervention group achieved an energy saving of 4.8% when compared to the control group over the course of Trial 1.

These results are statistically significant using the **energywise** threshold of 0.25. P-value of “Diff Ratio” = 0.114

### Payment Type – Prepayment

Outliers were excluded using the variable “Diff %” where they fell outside the range -60% to 48%

Group	N	Hhold Size	P1 (EAC)	P2 (Annual kWh)	Diff kWh (P2-P1)	Diff % (P2-P1) / P1	Diff Ratio (P2/P1)	DiD %
	Count	Mean	Mean	Mean	Mean	Mean	Mean	
Intervention	52	2.9	3249	2994	-255	-7.8%	0.92	
Control	15	3.3	3061	3102	41	1.3%	1.01	
<b>DID</b>	<b>67</b>						<b>0.91</b>	<b>9.1%</b>

N = number of prepayment metered households included in the analysis

This analysis showed that the intervention group achieved an energy saving of 9.1% when compared to the control group over the course of Trial 1.

These results are statistically significant using the **energywise** threshold of 0.25. P-value of “Diff Ratio” = 0.112

The **energywise** project has adopted a statistical significance threshold of 0.25. This is explained and justified in the original submission. This is in line with current guidance from the American statistical Association ‘The ASA’s statement on p-values: context, process, and purpose’ (Wasserstein and Lazar 2016) to evaluate appropriate statistical significance thresholds in the context of each study.

### Energy saving interpretation for prepayment customers

With any statistical calculation, there are a range of forms of uncertainty that can influence the results. Some of these can be explicitly quantified through measures such as tests of statistical significance – many, however, cannot. In the context of the findings on energy savings from the prepayment group, it is felt that the results must be interpreted with considerable caution because of the influence of these unquantifiable uncertainties.

There are a number of data quality issues specific to prepayment participants in the control group. As previously mentioned prepayment participants in the control group could not be issued with smart meters so were provided with alternative energy monitors. These alternative energy monitors did not provide the same quality of data as the smart meters in the intervention group.

One issue is that a substantial number of the alternative energy monitors stopped providing data during the course of the trial. This resulted in only 15 active participants in the prepayment control sub-group being eligible for inclusion in the analysis, i.e. only 15 participants (from an initial 30 active participants) had more than 300 days of electricity data for Trial 1.

A further issue is reduced confidence in the data provided by the alternative energy monitors used by prepayment participants in the control group. Although data quality processes were applied to this data, on visual inspection some remaining data points appeared anomalous, both in terms of their individual values, and their sequence of values (pattern). While these data points did not reach the threshold for rejection from the analysis, their anomalous nature reduced confidence in the data provided by these monitors compared to data provided by the smart meters.

Therefore, despite the results showing, theoretically, a relatively large effect size of 9.1% with a statistically significant p-value of 0.112, there should be less confidence attached to these results compared to the results of credit participants.

### 5.3 Trial 1 control group contamination effects

There are a range of factors that can impact on the integrity of the control group as a baseline against which to define savings in the intervention group. The primary factors that need to be considered in this context are:

- **Experimenter bias:** The possibility of researchers consciously or sub-consciously treating participants differently in the intervention and control groups in ways that bias the outcome.
- **Differential attrition:** Participants dropping-out of the trial for different reasons in the intervention and control groups in ways that bias the trial outcome.
- **Selection bias:** Anything that gives rise to differences between the intervention and control groups at the start of the trial. This could be due to a range of factors including random chance. The more factors there are that influence the outcome variable of interest, then the more likely it is that by chance the intervention and control groups will differ significantly at the start of the trial.
- **Diffusion:** The effect of the intervention diffusing between the intervention and control groups, for example if participants in both groups were neighbours and discussed the trial, the control group participant may change their energy behaviour thus influencing the trial outcome.
- **Rivalry/demoralisation:** The impact of trial participation and participant group allocation (as opposed to the impact of the intervention) on occupant behaviour in the intervention or control groups.

In the context of the **energywise** project, the primary concerns are selection bias and differential attrition between the intervention and control group. Differential attrition can contaminate the control group by defeating the randomisation process by which the groups. Assuming the integrity of the randomisation process (and there have been no reports of any breaches of this from project partners), then the intervention and control groups should start out being statistically insignificantly different. This of course, does not mean that they would be identical. As the analysis of household size shows, there is one eight-person household and one nine-person household in the trial. By definition these must end up in either the intervention and control group with there being a 1:4 chance of them both ending up in the same group. As it happens, they have both been allocated to the intervention group in the trial. In addition, there seems to be a skewing of the distribution of household sizes towards the smaller household size in general within the control group and the larger household size within the intervention group. This falls within the range of expected random variation between the groups so could be entirely independent of any trial induced contamination effects.

An alternative explanation is that this difference may have arisen due to a greater number of dropouts from the control group than from the intervention group. This is an example of differential attrition, possibly through demoralisation. Some of the qualitative feedback returned from the CFOs and researchers participating in the focus group meetings suggest that there has been some level of dissatisfaction/misunderstanding around the participants in the control group not receiving the smart meter and energy savings devices at the start of Trial 1. Theoretically this may have given rise to a greater propensity for participants within the control group to withdraw from the trial thus making the intervention and control groups unequal. However, the impact of this effect on the capacity to draw statistical inferences from the findings of the **energywise** project appears to be minimal. While balanced intervention and control group sizes in trial maximises statistical inference for any given number of participants, small imbalances (less than 2:1) have little effect on inferential power (Cohen, 1969). With 46% of active participants in the control group and 54% in the intervention group at the end of Trial 1 (as per volumes of

active participants reported in Table 6 of 17 February 2017), the effect on the trial's statistical inference will be minimal.

**Table 6: Active participants in intervention and control group as of 17 February 2017**

Payment Method	Intervention	Control	Current Total
Credit	105	95	200
Prepayment	56	41	97
<b>Grand Total</b>	<b>161</b>	<b>136</b>	<b>297</b>

The project maintains a log of participants withdrawing from the project (a 'dropout tracker') which includes notes from the customer field officers on the reason for the withdrawal. Analysis of the qualitative data in this shows that only two participants in the control group withdrew due a reason linked to that group. In both cases this was because they didn't receive the interventions (specifically the Smart Energy Display). All other reasons given are shared across withdrawals from both the intervention and control groups.

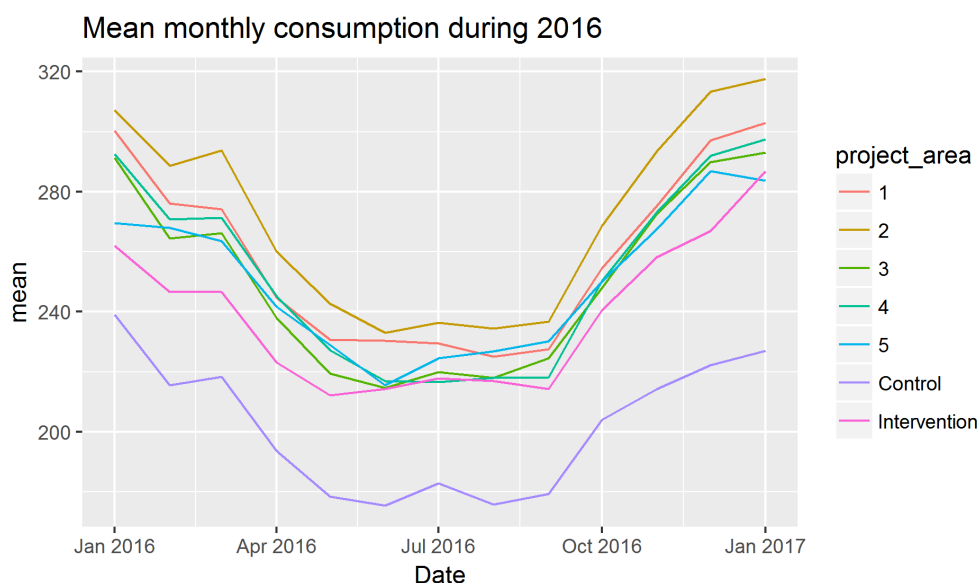
In addition to there being only two cases of control group participants dropping out for differential reasons, for this differential attrition to impact upon the findings of the trial, it would be necessary for the additional dropouts from the control group to be non-random. In this case, there would need to be a greater propensity for larger households to have dropped out of the trial if they were in the control group. Analysis of these two cases shows that this was not the case. Alternatively, one could imagine that differential dissatisfaction in trial participation between the intervention and control groups would disproportionately impact on larger households if it only takes one household member to object to the participating for the household to withdraw. If each household member is independently equally likely to more strongly object to being in the control group to the intervention group, then this would increase the probability of the household dropping out as household size increased. Again, no evidence of this has been found from the drop-out analysis.

An additional form of analysis for contamination effects was carried out with the data from the external control group. An analysis of variance (ANOVA) test was conducted across the five climate regions into which the external control group data was aggregated, with the intervention group in Tower Hamlets. It is important to note here that the external control group data is primarily required for Trial 2 and hence contains British Gas customers with dual fuel or electricity smart meters – they are therefore expected to behave in a manner similar to those in the intervention group in Tower Hamlets (not the control group for Trial 1). For further details see Appendix A: External Control Group. The analysis of variance test of the data across all regions' smart metered participants showed that there was no significant difference in the change in the means of the groups' consumption between January 2016 and January 2017. This shows that the intervention group in Tower Hamlets behaved in a statistically similar manner to smart meter customers in each of the other climate regions across Great Britain.

This can be seen graphically in Figure 34 below. In this figure:

- Area 1 includes the UK Power Networks areas East England, London and South East England, as well as Southern England (Southern Electric Power Distribution).
- Area 2 includes the Western Power Distribution regions of the East and West Midlands
- Area 3 includes North West England (Electricity North West); North Wales, Merseyside and Cheshire (Scottish Power Energy Networks) and South Wales (Western Power Distribution)
- Area 4 includes the Northern Power Grid areas of Yorkshire and North East England
- Area 5 covers South Scotland (Scottish Power Energy Networks)





**Figure 34: Mean monthly consumption of the external control group climate regions, and Tower Hamlets intervention and control groups in 2016**

Figure 34 also clearly shows the lower consumption of the Tower Hamlets' control group as discussed elsewhere in the report. It is important to note here that this analysis for contamination effects is not, and should not be compared with the difference in difference analysis conducted to calculate the savings arising from Trial 1.

Two forms of evidence therefore support drawing the conclusion that contamination effects have not effected the findings from Trial 1. Firstly, case by case analysis of the stated reasons of withdrawal from the trial shows no evidence of systemic differences for reasons for withdrawal between the intervention and control groups. Secondly, analysis of variance shows that the annual consumption profile of the intervention group *is not* statistically significantly different from similar consumers in the five external control group regions (Figure 34) – while the difference in difference analysis reported in Section 5.2 shows that the intervention and control groups *do* follow statistically significantly different trajectories over the course of Trial 1 (Figure 33).

## 5.4 Statistical generalisation

The research design for **energywise** was developed as a balanced response to the need for robust findings that can be generalised to UK Power Networks and Great Britain, tensioned against the costs to the project and the logistical constraints of working with vulnerable and fuel poor customers in a constrained geographical area.

The design of the trials were based on two main objectives:

- Firstly, the capacity to say (with a known level of statistical confidence and power) the likelihood that the effects of the interventions are real (**internal validity**);
- Secondly to be able to say how likely it is that the energy savings and shifting observed in those who received the interventions apply generally, i.e. would happen if the same interventions were replicated elsewhere (**external validity**).

At bid, the project external validity sample size was based on being 90% ('Z' in the equation below) confident that the project's estimate of the mean energy savings in the population (i.e. other DNO regions) would lie within 5% ( $\pm 2.5\%$ ) ('A' in the equation below) of that observed in the **energywise** intervention group. As discussed in the project's bid submission, a sample size of 271 resulted. This is based on the standard assumptions of inductive statistics and was calculated using the standard equation for statistical generalisation produced below.

The inputs used in this inductive statistics calculation for the **energywise** project were as follows:



$$n = \frac{\left( \frac{P[1-P]}{\frac{A^2}{Z^2} + \frac{P[1-P]}{N}} \right)}{R}$$

- N = The population was set at 260,000 based on information from UK Power Networks on the number of people on the Priority Services Register at bid time in 2013. While this is an underestimate, sample size does not change for population sizes above this value.
- P = 0.5. This is assuming that half the population will save more than the estimated median energy savings of 6% and 50% will save less than 6%. This figure of 6% was the estimated median energy savings calculated during the trial bid through looking at the range of energy savings observed in other trials of similar sets of interventions in the UK and Ireland.
- A = 5%
- Z = 1.6449 for 90%

The requirements for 90% statistical confidence for the external validity calculations were not the limiting factor on the sample size calculations which was dictated by those for internal validity. This required 275 in both the intervention and control groups (given the other input assumptions to the calculations available at the time) giving a total of 550 participants. At the end of Trial 1 there were 297 participants in the trial. This allowed the project to estimate the mean energy savings in the population represented by the **energywise** sample to within 5% ( $\pm 2.5\%$ ) of that observed in the **energywise** intervention group with ~91.5% confidence (under standard external validity assumptions). With no evidence of control group contamination effects as discussed in Section 5.3, the observed 3.3% savings of the intervention group relative to the control group in Trial 1 is expected to be seen in other DNO regions replicating this trial. Further details on issues of generalisation are provided in Appendix A.

## 5.5 Qualitative insights

The research has been designed to enable qualitative insights into participants' energy using behaviour to be captured. This is done through recording observations of the interactions that the CFOs have with participants at their homes while carrying out the HES. The HES is typically done with residents' participation helping the CFOs to document the electricity using appliances in their homes and record socio-demographic information. This interaction can generate broader conversations about energy use at home, and the CFOs have been trained to record any qualitative insights generated through these interactions. After each visit to a home for an installation, the CFO should make notes about any comments made by the participants about energy use. They also document their own observations about the use of the energy in the home, for example noting if the lights are on in the day, or the television.

The objective is to create a set of qualitative notes that provide qualitative data on:

1. Engagement with the **energywise** project (recruitment channels, materials, experiences etc.); and
2. Lifestyles and impact on energy use in the home (e.g. family routines, health, use of appliances).

The qualitative notes are structured around four themes; energy types, life and routines, energy issues, **energywise** experience and are flexible enough to enable other observations to be recorded. Capturing these insights has been carried out where possible. In total qualitative notes for 159 participants have been collected by the project<sup>19</sup>.

When analysing the qualitative notes, it appears that there are two areas that are of particular interest for the project research; firstly appliance use and comfort practices and secondly daily routines and appliance use. The

<sup>19</sup> This figure includes 43 sets of notes from participants who left the project after their HES/installation visit was carried out and the notes created.

notes also provide some useful insights for the project implementation including comments on the project materials and the experience of filling in the surveys.

### 5.5.1 Heating practices and thermal comfort

Comments on heating are common in the notes database (present in 112 out of 159 records) and raise two issues; firstly the choices people make about how to keep warm which may or not involve using central heating or electric appliances; secondly strategies which people use to keep warm when their central heating is faulty.

#### Alternative heating practices

Three participants commented that they avoid using their central heating because they do not like the feel of it. For example, for one it brought out her son's allergies another explained that in winter he *'tends to dress warm and use halogen heaters if necessary as central heating gives him a migraine'*, while another explained *"they don't use heater or heating during winter a lot as the wife has a skin condition which is worsened with heat. Tend to wear more clothes to keep warm"*.

Others explained they tried to reduce their use of central heating to reduce their outgoings. For example *"customer often uses electric fire and not central heating as it 'costs too much", "Uses heat blanket to keep warm during winter" or "even during winter the customer stated they try not use the heating"*.

Two participants spoke about preferring the instant heat from additional heating and using central heating at other times. For example, a CFO has noted that one household *"want to get warm instantly when they get home from work they use additional heating instead of the central heating that takes longer to heat up. Central heating is on later in the evening and weekends when home"*.

These comments indicate a variety of heating practices that may have an impact firstly on the project's implementation. Such alternative practices will be hard to detect with the temperature loggers and may mean the project team makes inappropriate interventions. For example a person might be wrongly flagged as living in a cold home, when the customer is warm enough due to their chosen alternative heating practices. Of more concern though are the cases where the central heating is faulty and the landlord needs to take action, rather than the tenant. In these cases intervention may not solve the issue.

#### Faulty central heating

Faulty central heating was mentioned in six cases and four of these participants explained that they had to use additional electric fires to compensate. One provided their perspective, explaining that *"the heaters don't work properly"* and that *"they think new radiators might make a difference to heating but also to bills"* however as a social tenant, their housing provider is responsible for maintaining radiators. The participant therefore has limited options to improve the heating system in their home. The CFO team encourage any participants experiencing problems to contact their social landlord directly.

These comments raise concern about the ability for fuel poor customers to realise the benefits of a time of use tariff as the household's ability to respond to the benefits of cheaper electricity offered in a time of use tariff will be limited. In the worst cases where electric appliances are being used to compensate for faulty gas central heating or poorly performing buildings, the participant may incur higher bills for continuing to use electric appliances to heat, or may under heat in order to save money.

### 5.5.2 Routines and appliance use

The qualitative notes raise a number of insights about how family life and domestic routines affect appliance use. Research carried out on for the LCNF CLNR qualitative data project has raised the issue of how domestic routines affect DSR measures. This is because some household routines which are shaped by broader societal rhythms such as school times and working hours are less able to be shifted temporally to lower peak demand

For the participants in the **energywise** trial there are a series of insights from routines and appliance use that may affect a household's ability to respond to time of use tariffs and shift their electricity consumption patterns.

### Appliances move around with extended family members

The qualitative notes indicate that as extended family members move between households they alter not only the pattern of electricity consumption, but also the appliances in the home. For example one respondent explained that *“every weekend the grandchildren visit and bring their PS3 and Xbox with them”*. Childcare and appliance use appear to be connected with tablets, laptops, TVs and consoles all mentioned as appliances used by younger children, whether these are resident in the home, or visitors. The pattern of childcare and its associated electricity use may prove hard to shift unless people associate childcare with electricity consumption and see this as an area of consumption that can be altered in line with tariffs.

Another factor mentioned by some participants is that extended family members help out in the home, for example one person stated that their *“daughter visits twice a week to help out with the cleaning, washing & bills etc.”*. This again shows that the timing of appliance-use is tied to dynamics that extend out of the immediate household and bill payer's control.

This raises interesting questions about the extent that extended family members can support or undermine a household's ability to respond to time of use tariffs. The ESC survey provides insights into the type and extent of resources that participants have within their social networks to understand electricity and energy efficiency in the home as well as how this form of social capital is operationalised. Further research could look specifically at the question of using these ESC resources to realise benefits of time of use tariffs.

### **5.5.3 Participant comments on the energywise project**

In addition the qualitative notes contain some insights that are useful for learning lessons about the design and implementation of the project. The notes contain 52 comments on surveys and these show that almost all found them easy to fill in. Only one person found the HES time-consuming, while two found the focus on appliances and brands a little confusing. Three people raised concern about the confidentiality or sensitivity of the data, specifically mentioning the income questions. More positively, two people specifically mentioned that having a Bengali-speaking CFO was a help.

Overall, the low level of concerns or comments about the surveys suggests that they were well designed and well administered making them easy to fill in for the majority.

### **5.5.4 Qualitative feedback from participant interviews**

In April 2016, qualitative telephone interviews were held with 30 **energywise** participants, selected at random within a sample frame designed to ensure proportionate interviewees by group and sign up method, to gather feedback on the recruitment and installation and also, for intervention group, on their energy display and devices. Those in intervention group were generally very positive and there are some reports of energy savings.

- *“It's a very good project, it's very useful. You can manage your budgets much better. I used to put £25 a week on my meter, now I put in £20 every other week. It's a big saving. The meter helps me to know where I'm at.”*
- *“Everything has run smoothly. I think the new meters are good. I've heard the scare stories, but I wouldn't want to change it.”*
- *“I'm on a pay as you go meter – it's great to see on the energy display how much energy I'm using, and when I need to top up.”*

16 intervention group interviewees were interviewed as part of this research. However, one of these interviewees chose not to answer the questions about their use of the equipment supplied as part of the trial. All of those who did answer these questions had received the equipment, although one participant suggested that they had only received one LED light bulb (although the field officers had recorded this participant receiving three bulbs).

### **5.5.5 Kettle**

Eight of the 15 interviewees said they were using their energy saving kettle. Some of those who were using it were extremely positive about it, with two people commenting on the energy saved and one on the speed with which it boils water. For example, one interviewee, when asked what they thought of the kettle, responded:

- *"It's brilliant. You can just fill up what you need, rather than too much"*

Others who were using the kettle were less positive about it, with negative comments being made about the quality of the materials used, its appearance and its weight. A number of interviewees had taken time to adjust to the kettle, with some not fully understanding how to use it at first. For example, one interviewee had been frustrated about the amount of water which could be boiled in the kettle and had only just learnt that the water in both chambers could be boiled at the same time. One interviewee suggested that a sticker on the kettle handle with simple usage instructions would have been helpful.

Seven of the 15 interviewees were not using their energy saving kettle. Reasons cited included:

- The kettle had stopped working (two interviewees);
- The kettle was difficult to use, e.g. an elderly participant found the button to release the water too difficult to push, whilst another simply found this process annoying;
- The kettle had insufficient capacity;
- The kettle was not needed (this participant said that they rarely boiled water); and
- The kettle was too heavy.

### **5.5.6 LED light bulbs**

11 of the 15 interviewees said they were using their LED light bulbs. They were being used in a variety of different rooms.

All those who were using their bulbs were happy with their performance. Some commented on their performance in terms of the light they provided, whilst others commented on the energy saving aspect. Two minor concerns were expressed. One interviewee suggested that the LED bulbs were a little slow to react (this may have been a reference to other energy saving bulbs not supplied as part of the trial), whilst another found that they were a little too bright.

The four interviewees who were not using their LED light bulbs gave various reasons for this:

- One had just not got around to fitting them;
- One couldn't fit them because of being physically unable to reach the light fittings;
- One stated that the bulbs did not fit the light fittings they had; and
- One intended to use them but was waiting until their existing bulbs had failed.

### **5.5.7 Standby shutdown**

Seven of the 15 interviewees said they were using their standby shutdown. Those who were doing so were generally positive about it, with comments being made about its ease of use and its contribution to saving energy. As an example of the latter:

- *"The kids moaned a bit that they have to wait a bit in the morning for everything to come on, but I told them that we were wasting lots of money having it on all night, and they've got used to it now."*

Three of those who weren't using the standby shutdown said that the reason for this was not knowing how to operate it. Two others suggested that they didn't need it, as they turned everything off at night anyway. One was fearful of unplugging her TV and other devices in case they stopped working, whilst another intended to use it but hadn't got around to installing it yet.

### **5.5.8 Smart energy display**

13 of the 15 interviewees said they were using their smart energy display. Most of these were doing so regularly for monitoring energy use and, where relevant, credit. For example:

- *"It's in the front room. I use it to check my credit and how much I'm using each day."*
- *"It's by the side of my telly. It shows me what I'm using and how much credit I have left."*
- *"It's next to my microwave. It switches itself on at 6am. I check it in the morning and the evening."*



When asked if their behaviour had changed as a result of using their smart energy displays, seven stated that it had. In some cases this was significant. For example:

- *"It does help. You try and cut down on things. Instead of doing my washing every day, I do it every two days. And I use my tumble drier a bit less. I use a drying horse more"*
- *"Yes, big time. Seeing how much I was spending amazed me. Seeing how much the microwave and oven use, has made me much more aware. Me and my son (who's five) turn off all of the lights now. We never did that before"*
- *"The other day I was cooking a Sunday roast, the kettle was on, the washing machine was on - the display went up to the max, I realised how much it was using. I made the kids turn off the telly and go upstairs. They love reading. I'm more conscious of switching things off. I turn all plugs off at night. I have always been good with lights"*

In other cases, the interviewees felt that the changes they had made were more minor, with a number suggesting that they had always been very careful with their energy use anyway.

Two of the 15 interviewees said they were not using their smart energy display. One had experienced technical problems with the display and was unsure how to operate it. The other suggested that they had not found the device useful or clear and also expressed concern about the energy use of the device itself:

- *"It seems to defeat the object. It uses energy, although the team told me it doesn't use much"*

Seven of the 15 intervention group interviewees reported experiencing some problems in using their smart energy displays. They mainly described them as delays in credit showing up on the meter when topping up through the display. Customers are always shown at the installation appointment how to manually input the vend codes into their meter to top up in case of any potential delays in the communication between the smart meter and the display. In one instance, a participant did not remember how to do this and activated their emergency credit between making the top up payment and manually inputting the vend codes, which they claim was stressful. These customers now know how to top up manually, if necessary, so this situation should not reoccur.

### **5.5.9 Energy saving advice leaflet**

Six of the 15 interviewees said they had read the energy saving advice leaflet. Six said they had not read it, whilst two could not remember. One interviewee was not asked this question due to a lack of time.

Three of those who read the leaflet said they had found it useful but only one reported having implemented any of the advice in the leaflet. This interviewee suggested that they had implemented the advice about use of the energy saving kettle and about turning off devices not in use. This seems to correlate with the findings shown in Figure 17 to Figure 20 in Section 3.4, where picking up or reading a leaflet is not people's first response when looking for information on energy.

### **5.5.10 Qualitative insights from participant panels**

As detailed in Section 6 below, the project runs regular focus groups with participants in order to gain feedback and allow participants' to discuss their views and experiences of the project. The project has held four 'participant panel' meetings to date, with two groups of participants. For Trial 1 these were split between control and intervention group participants, for Trial 2 they were split between credit meter participants and prepayment meter participants. Each meeting had a specific topic (see Table 7 below), but the focus group format allows for participants to raise issues that they consider important and discuss these with the other panellists and the facilitating staff from BbBC, UCL and CAG. This means the panels provide the project team with further qualitative insights on participants attitudes and understanding of everyday energy issues.



**Table 7: Participant Panel dates and topics**

	Month	Panel composition	Topic
Panel 1	March 2016	Control & Intervention	Recruitment to <b>energywise</b> project & Installation
Panel 2	July 2016	Control & Intervention	Trial 1 equipment, communications & ESC survey
Panel 3	Nov 2016	Control & Intervention	Trial 1 equipment, communications & ESC2 survey
Panel 4	Jan 2017	Credit & Prepayment	Project communications for Trial 2

*The following insights were gathered as an outcome of the panel meetings:*

*Attitudes towards energy companies.*

In Panel 1 members discussed the recruitment process and their initial concern that **energywise** was a new energy company that was trying to switch them from British Gas. This concern was repeated in Panel 4 when participants discussed the communications material for Trial 2 and requested that it was made clear that this offer was from British Gas and did not mean switching. Overall, participants are sceptical towards new energy companies and loyal to British Gas, which they see as a dependable company.

*Attitudes towards energy efficiency technology (energy efficiency devices, smart energy displays and smart meters).*

A recurrent theme in the first three panels was that people are keen to have energy efficient devices, although struggle to make them work. The everyday items (kettles and light bulbs) are easier for people to use, although also easier for people to reject on the basis that they are not perceived to be as good, effective or aesthetic as the item they are replacing. The more unusual items (standby shutdown, smart energy display) raise some interest, but also some concerns, particularly amongst participants who lack confidence in managing electricity and don't want to mess up things in their home.

*Awareness of energy issues and projects:*

In Panels 2 and 3 participants were asked about other energy projects and showed a low level of awareness. One said they did receive notifications from their Local Authority about bulk switching, but tended to ignore it. Panel 4 included a short energy literacy quiz which showed participants had some confusion around how best to manage electricity economically at home. The majority of participants felt they were paying different amounts for their electricity at different times, some were unsure whether their showers used gas or electricity to heat the water. In the Panel 4 discussions about shifting the time energy is used it appeared that prepayment participants are more accustomed to managing electricity and money than credit participants. They were receptive to the idea of an energy shifting trial and discussed their own ideas of how they thought they or others could respond to it. In comparison, credit participants found the idea of a ToU tariff trial more problematic and found it more difficult to think how they could fit it into their lifestyle.

The general insights from the panels are:

- Participants feel that electricity is an area that can be economised;
- They have some tolerance of spending time and effort in understanding devices that might help them to save money;
- However, there is confusion around how to manage electricity in the home; and
- Face to face advice and demonstrations are needed by many to ensure and enable uptake and effective use of energy efficient devices.

## 6 Network insights

### 6.1 Half-hourly network modelling

#### 6.1.1 An introduction to the Element Energy Load Growth model

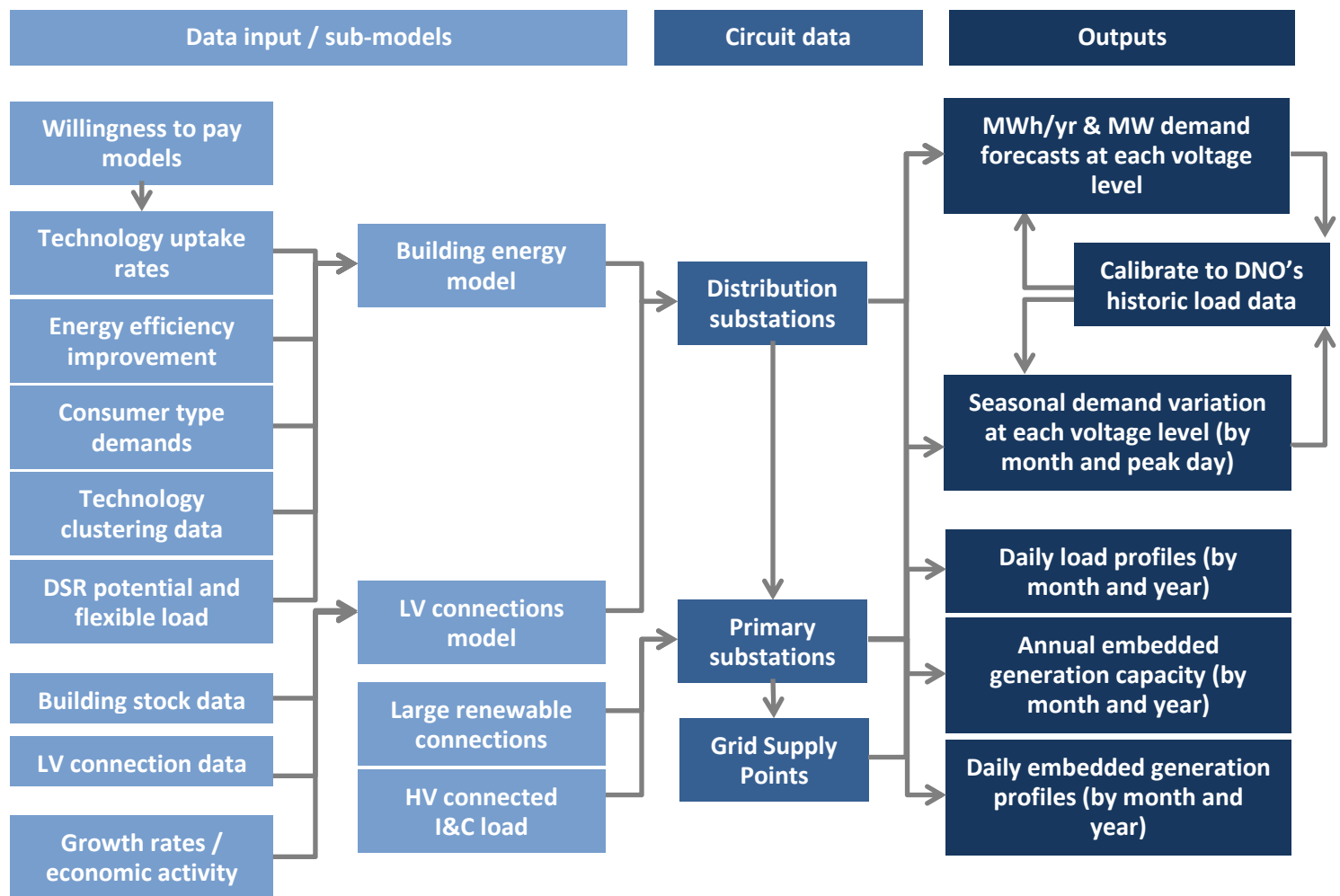
To model future loads across its three licence areas, UK Power Networks makes use of a load forecasting scenario tool developed by Element Energy that is specific to their network structure and is capable of forecasting load growth resolved to the level of individual distribution substations. The Element Energy Load Growth (EELG) model combines detailed data on the mix of domestic properties and business types, resolved to postcode sector level, with an accurate representation of the networks, in terms of the locations and connectivity of assets, in each licence area. This allows the load connected to each substation to be modelled on the basis of a highly resolved understanding of the customer mix. The EELG model also incorporates a comprehensive set of scenarios for future load growth, based on:

- Population and economic growth along with evolution of the building stock;
- Energy efficiency improvements in the domestic and commercial & industrial sectors;
- Uptake of a broad range of low carbon technologies such as electric vehicles, heat pumps (domestic and non-domestic), wind power, solar photovoltaics and domestic micro-generation; and
- The changing policy landscape and evolving consumer behaviours and appliance ownership patterns.

These scenarios are informed by a combination of historical trends, government projections and Element Energy's modelling of the uptake of energy efficiency measures and low carbon technologies<sup>20</sup>. These models forecast the impact of differing assumptions regarding financial incentive regimes, technology costs, performance improvements and energy costs on the rate of uptake, based on a detailed understanding of consumer purchasing behaviour (informed by extensive consumer surveys). A simplified schematic of the EELG model is shown in Figure 35.

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<sup>20</sup> Developed in earlier work for the Committee on Climate Change, the Energy Technologies Institute and the Department for Transport.



**Figure 35: Simplified schematic of the EELG model**

The following are key outputs of the EELG model, which can be forecast for each substation and at each voltage level across the licence areas:

- Annual peak demand (MW);
- Total annual consumption (GWh);
- 24-hour demand profiles (MW) for a selected month and year; and
- Annual generation capacity connected (MW) for PV, wind and combined heat and power (CHP) along with their 24-hour generation profiles for each desired month and year.

Figure 36 shows two example output charts, which can be generated at different network levels, i.e. each of the UK Power Networks' licence areas, grid supply points, primary and secondary substations.

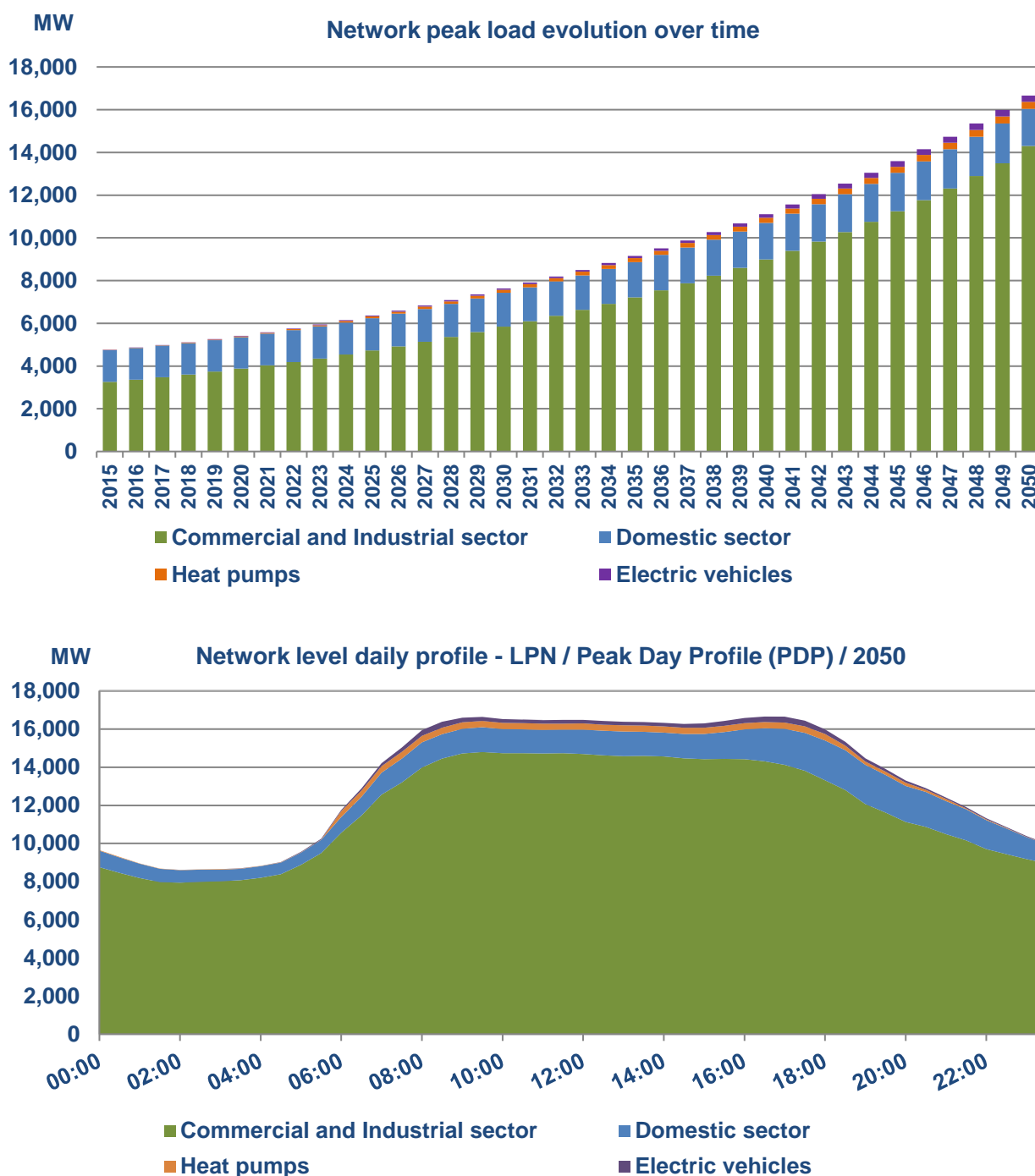


Figure 36: Example outputs from the EELG model. The top chart shows the evolution of peak load over time at network level. The bottom chart displays a typical load profile forecast for a specific future year at network level

### 6.1.2 Updates to the Element Energy Load Growth Model

The EELG model is regularly updated to incorporate new network, consumer and trial datasets as they become available as well as to account for changes in the economy, government policies and the cost and performance of various technologies. An important model update was carried out in 2015, as the datasets and learnings from various LCNF projects became available. In particular, extensive smart meter data for 5,510 customers and appliance ownership data for 2,830 households in the London Power Networks plc licence area were obtained



from the LCL trial and integrated into the EELG model. Load profile datasets for various low carbon technologies and use cases were also obtained from LCL and the CLNR project.

Using these datasets, the domestic sector components of the EELG model were modified to accommodate the load profile data of nine household archetypes defined in the LCL project (based on a 3x3 matrix of household size and income). The new domestic customer archetypes and appliance ownership characteristic also allow a more detailed breakdown of energy efficiency impacts and evolving appliance usage characteristics on the load profiles of each of these customer archetypes. Additionally, Element Energy has updated the load profiles of heat pumps and electric vehicles (EVs) with the latest technology monitoring data from LCL and CLNR.

For the current **energywise** project, the EELG model was further modified to also address fuel poor household archetypes in the domestic sector. In addition to the 3x3 household types defined during LCL, the model has now been expanded to be able to also consider 3x4 household types:

- Three occupancy levels: 1, 2 and 3+ person households; and
- Four affluence levels: affluent, comfortable, adverse and fuel poor.

The appliance ownership data obtained from the household surveys conducted in the **energywise** project is also applied to the appliance ownership characteristics of the fuel poor consumer archetypes in the EELG model (in the same way the LCL appliance ownership data is applied to the other household archetypes). Based on these additions to the EELG model, at the completion of the **energywise** trial, it will be possible for UK Power Networks to integrate additional visibility and understanding of fuel poor customers, and how they respond to energy saving and demand shifting interventions, into its network planning processes.

## 6.2 Half-hourly household load profile trial data

### 6.2.1 The energywise half-hourly household load data

This section provides an overview of the half-hourly trial participant load data from the **energywise** project, which is then compared to that of other GB smart meter trials. Similarly, the load profiles of the **energywise** trial participants are also compared to the network load profiles at the primary and secondary substations connected with the **energywise** trial.

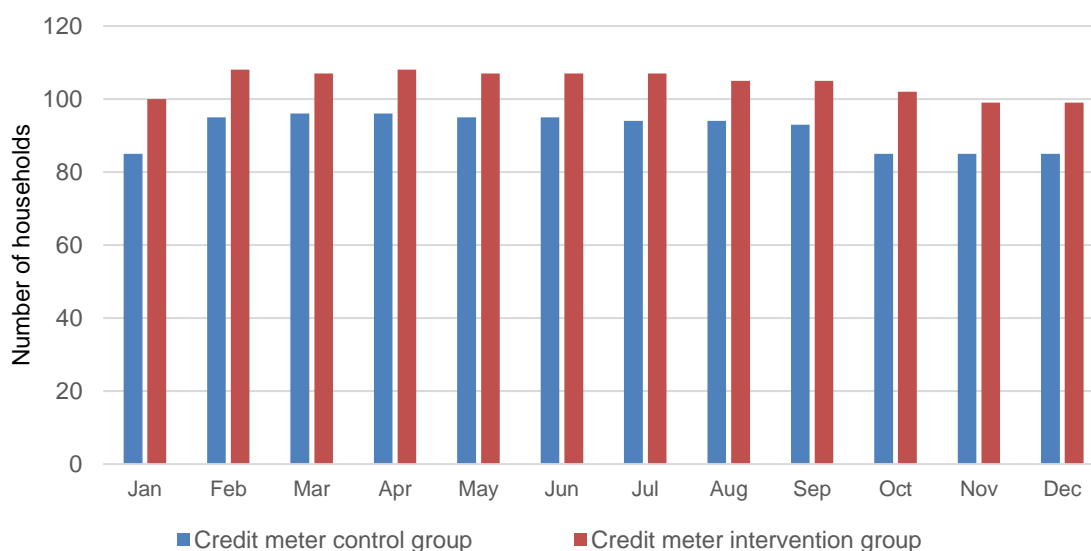
The half-hourly smart meter data shown in this chapter covers the period from 15 February 2016 to 14 February 2017 of Trial 1<sup>21</sup>. Since half-hourly data was not available for the prepayment customers in the intervention group, this chapter focuses on the half-hourly data for credit customers. As Section 5.2 demonstrates, the trial participants in the credit meter intervention group had a higher electricity demand compared with the control group. The Difference in Difference (DiD) analysis revealed that the demand of the intervention group decreased more than the demand of the control group (each compared to their respective pre-trial consumption). For consistency with the analysis in Section 5.2 that used the daily consumption data (which is more complete across the participant households than the half-hourly dataset) the following sections present half-hourly load data that has been calibrated<sup>22</sup> to reflect the savings in consumption observed using the daily consumption data. The following participants have been excluded from the half-hourly data processing:

- Participants that dropped out of the trial before 15 February 2017;
- Participants for which an Estimated Annual Consumption (EAC) (pre-trial) was not available, and;
- Outliers that did not fall between the Inter Quartile Range (IQR) x 1.5 IQR of Tukey's method, as described in Section 5.2.2.

<sup>21</sup> It is worth noting that this is slightly different to the data range used in the previous chapter (owing to the different availabilities of daily and half-hourly data in Trial 1) which covered the first 365 days that each participant reported (i.e. a time period for which half-hourly data is not complete). Furthermore, not every household that reports daily data also has half-hourly data available.

<sup>22</sup> Calibration involved scaling the half-hourly profiles of the control and intervention groups to reflect the total annual consumption and DiD savings levels reported in Section 5.2. This calibration step preserves the shape of the profile, while reflecting the annual consumption and savings levels reported in Section 5.2 (which were obtained using the more complete data on daily consumption levels across all trial participants).

Figure 37 illustrates the number of households for which half-hourly household monitoring data was available at the time of preparing this report. Note that any dropouts, outliers and households with missing EACs are not considered in the subsequent analyses. Also note that the half-hourly data (monitored from 15 February 2016 to 14 February 2017) is visualised from January to December for simplicity, and to facilitate comparison with other trials (i.e. January data refers to January 2017, the first half of February data is taken from 2017 and the second half from 2016, while the other months are taken from 2016).

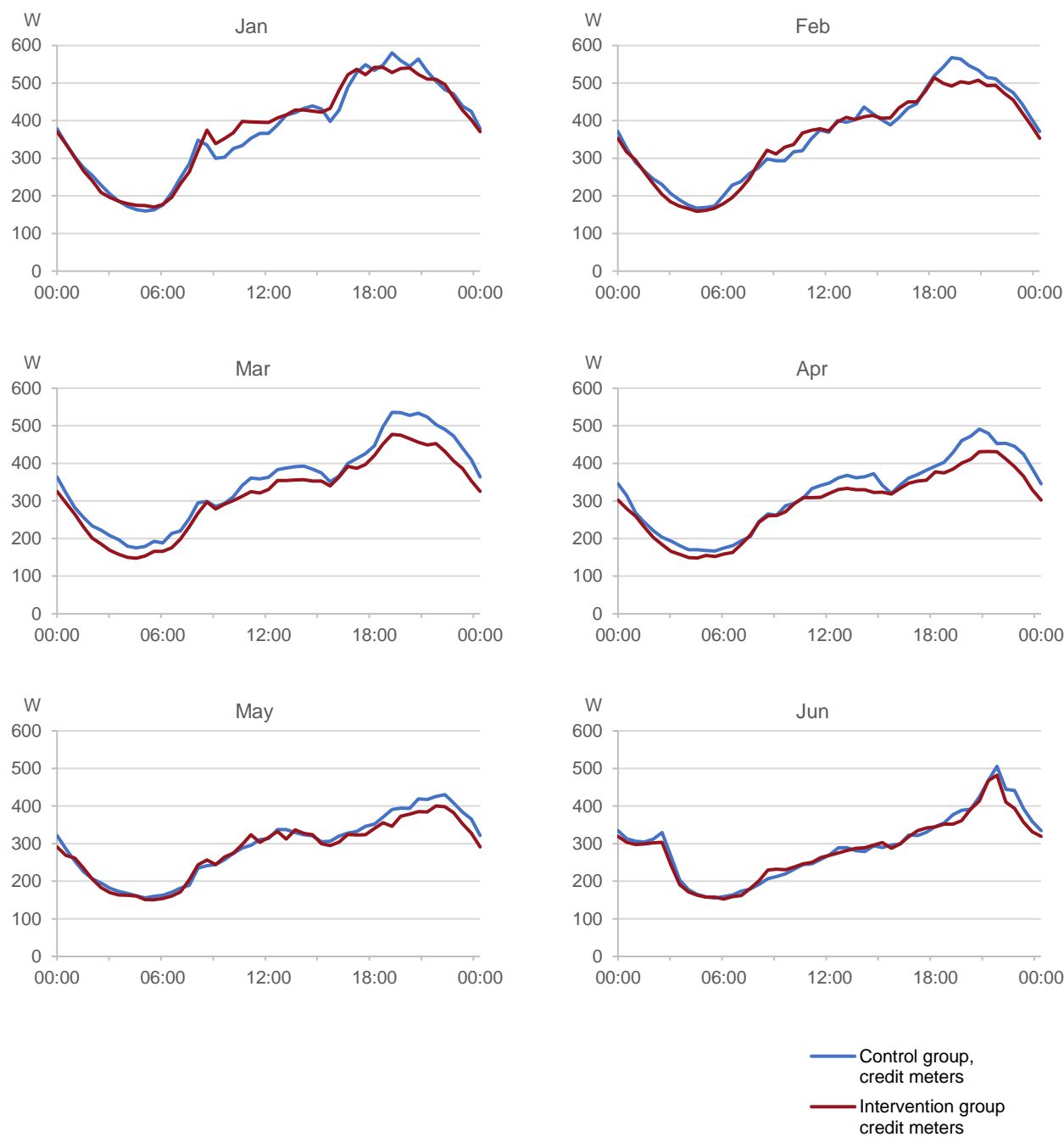


**Figure 37: Number of trial participants for which half-hourly data is available**

The following sections address the filtered and calibrated half-hourly monitoring data of the credit meter customers<sup>23</sup>. Figure 38 displays average diurnal load profiles by calendar month, derived from the half-hourly data monitored from 15 February 2016 to 14 February 2017 in Trial 1.

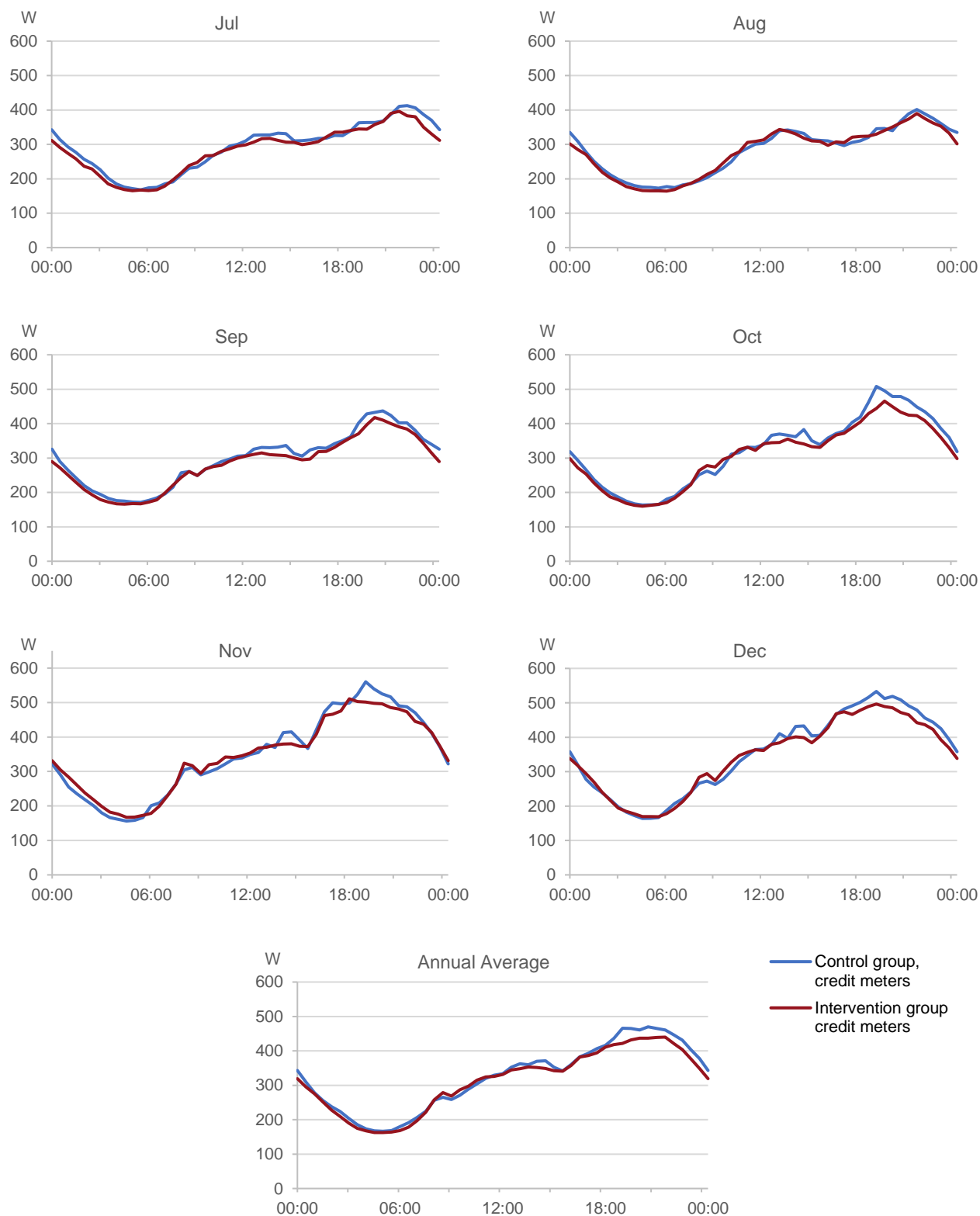
<sup>23</sup> Since half-hourly data was not available for the prepayment meter intervention group, prepayment meter customers are excluded from the analysis shown in Sections 6 and 7.

Diurnal load profiles, monthly averages from half-hourly data (monitoring period: Feb'16 – Feb'17).



**Figure 38: Diurnal load profiles of energywise trial participants across calendar months. The consumption levels of the intervention and control groups have been calibrated in line with the consumption and savings data reported in Section 5.2.2.**

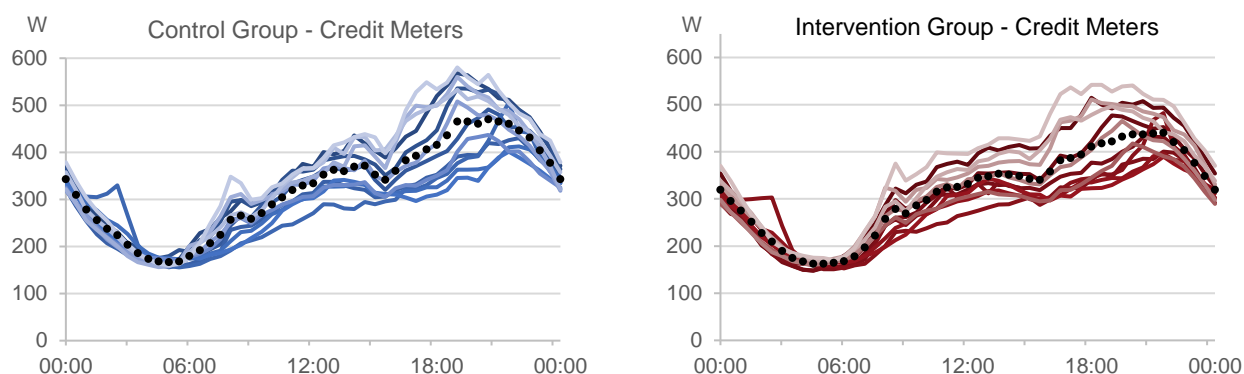
Continued - Diurnal load profiles, monthly averages from half-hourly data (monitoring period: Feb'16 – Feb'17).



**Figure 39: Diurnal load profiles of energywise trial participants across calendar months. The consumption levels of the intervention and control groups have been calibrated in line with the consumption and savings data reported in Section 5.2.2.**



In addition to the monthly breakdown provided in Figure 38 and Figure 39, the charts below group the monthly diurnal load profiles by trial group.

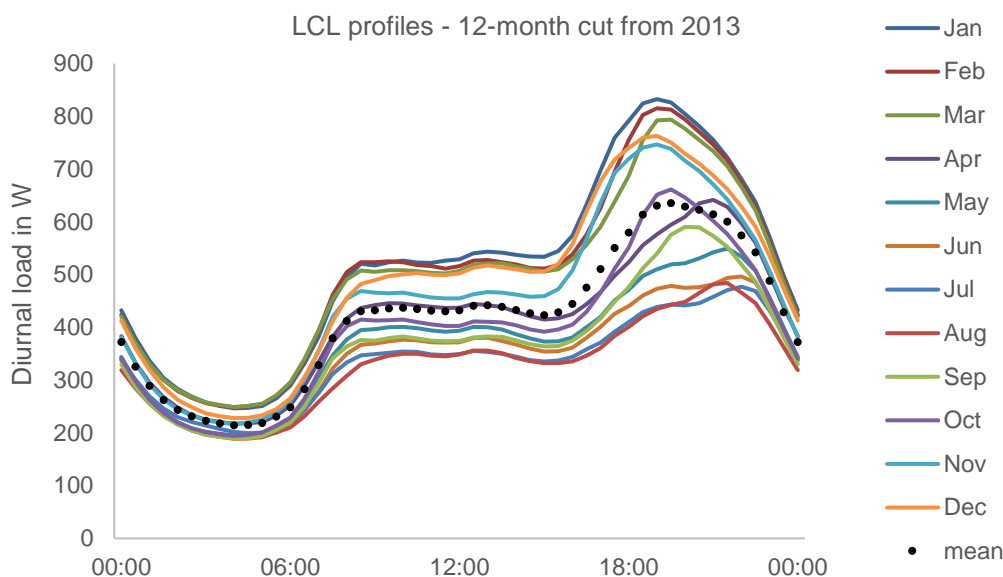


**Figure 40: Monthly diurnal load profiles of energywise trial participants (annual mean in black dots). The consumption levels of the intervention and control groups have been calibrated in line with the consumption and savings data reported in Section 5.2.2.**

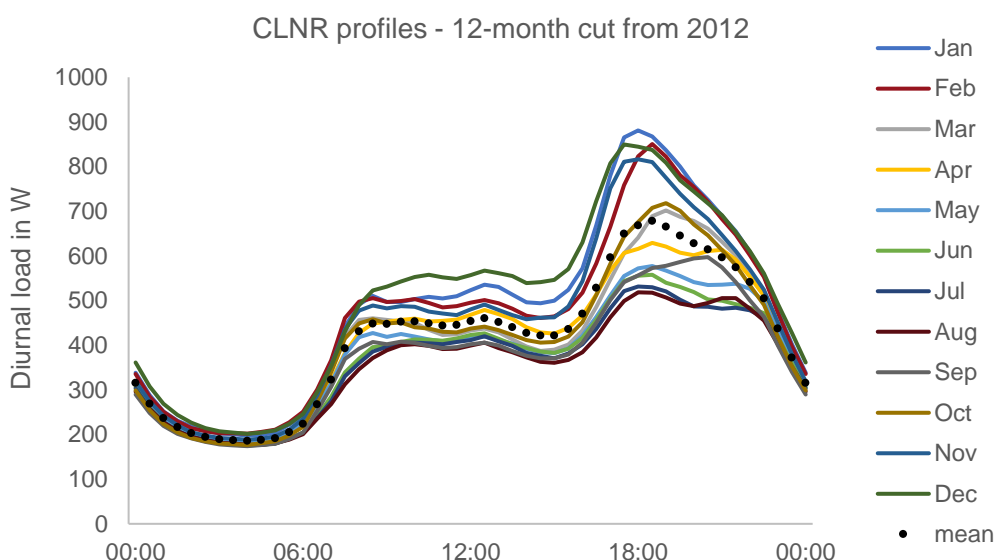
The control and intervention group generally have a very similar profile shape. The intervention group shows a lower demand during the evening peak (particularly in Feb, Apr, Mar 2016). It is worth noting that there is an observable change in behaviour in June 2016. From midnight to 6am, the demand of both the control and intervention groups did not decline as seen in other months. Rather, the electricity demand stayed almost constant until 2:30am. This may be due to changed household activity patterns during Ramadan (6 June – 5 July 2016), which is observed by a significant proportion of the community in the recruitment area.

### 6.2.2 Comparing the energywise household load data with that from LCL and CLNR

In this section, the half-hourly load data from the **energywise** control group is compared with the results observed from the LCL and CLNR smart meter trials. Both the LCL (Figure 41) and CLNR (Figure 42) projects conducted smart meter trials with large control groups, which serve as a reference for comparison with the **energywise** trial data.



**Figure 41: Diurnal load of LCL control group participants. The data represent the load of households in the regular smart meter trial (no interventions) monitored in London during 2013.**

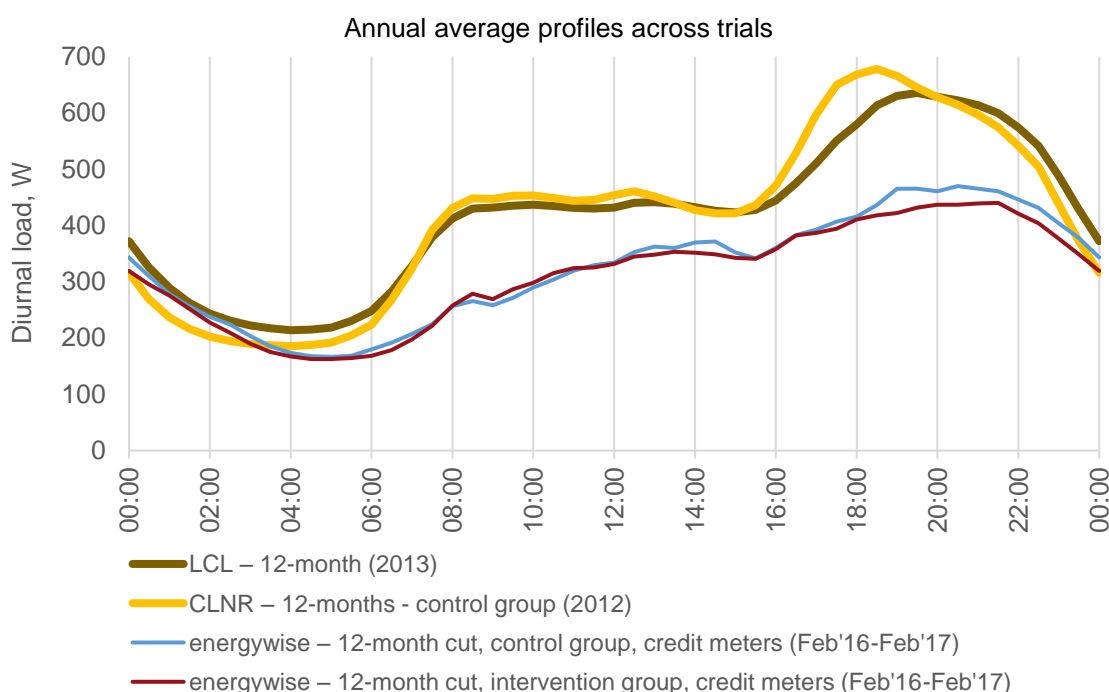


**Figure 42: Diurnal load of the CLNR control group – referred to as “test cell 1a” (TC1a). The data shown here represent the average load of households monitored in the UK for the year 2012.**

The average household diurnal load profiles observed across the **energywise** trial groups (Figure 40) reveal common trends that were also observed in other smart meter trials such as LCL (Figure 41) and CLNR (Figure 42):

- The consumption and peak load is higher during the winter months;
- The evening peak occurs relatively early during the winter season and moves to a later time in summer; and
- The characteristic shape of the diurnal profiles in each trial remains similar over these different seasons with an increase in “peakiness” (i.e. an emphasising of the evening peak) during the winter period.

Figure 43 below compares the annual average household load profiles across the **energywise**, LCL and CLNR control groups. It can be seen that the average consumption of the **energywise** trial participants is considerably lower than that observed for the LCL and CLNR trials over the same months. This is in keeping with the findings of the LCL trial analysis<sup>24</sup> of the impacts of household income on average diurnal consumption profile and reflects the demographic composition of the participants in the **energywise** study, which is targeted at fuel poor customers.



**Figure 43: Annual average profiles across the control groups of LCL and CLNR smart meter trials in comparison to energywise. The consumption levels of the intervention and control groups have been calibrated in line with the consumption and savings data reported in Section 5.2.2.**

It is interesting to note that the load profiles of the **energywise** participants display a relatively lower morning demand (between about 6am and midday) and evening peak demand (between about 5pm and 9pm) than observed in the other trials. The reduced evening peak has particularly important implications for DNOs since peak network loads typically occur during this period.

The evening peak of the **energywise** and LCL trials occurs slightly later than that observed for the CLNR trial. This may be indicative of geospatial and lifestyle differences of the London-based participants of the **energywise** and LCL trials relative to the broader GB distribution of CLNR trial participants (about 50% of which were from the Northern Powergrid network region and 50% were recruited more broadly within the GB).

The **energywise** trial participants also exhibited relatively high early morning (between about midnight and 3am) demand levels. In absolute terms, the early morning demand levels are comparable to those of the higher average energy consumers in the LCL and CLNR trials.

### 6.3 Half-hourly network load profile data

An important objective of the **energywise** project is to understand how network loads are impacted by fuel poor customers and their engagement with energy efficiency and demand shifting interventions. To provide some early insights in this area, the following sections of this report provide a comparison of the average load profiles of

<sup>24</sup> Element Energy, "LCL Learning Report C3 – Network impacts of energy efficiency at scale", for UK Power Networks, 2014

**energywise** trial participants with the network load at the secondary and primary substations that the trial participants are connected to. Primary and secondary substations are key nodes on the electricity distribution network at which network voltages are transformed. Within UK Power Networks' London Power Networks (LPN) licence area, there are 234 primary substations, which connect to 17,791 secondary substations, which in turn connect (via feeders) to various end-users (e.g. households and businesses) served by the network. Of the many primary and secondary substations within LPN, this project deals only with those connected, via the network hierarchy, to the participants on this trial.

### 6.3.1 An introduction to the half-hourly network data

UK Power Networks has identified all the secondary and primary substations the **energywise** participants are connected to using the MPAN associated with each household. 111 secondary substations have been identified within the trial area associated to all the 538 recruited households, which are connected to seven different primary substations. Screening out any customer drop-outs registered by the 14 February 2017, active participants are connected to 81 secondary substations out of the 111 identified secondary substations that are transferring data through a Remote Terminal Unit (RTU). The remaining substations do not have a configured RTU installed (therefore no data is available from them). All available secondary substation datasets have been used in the following analysis. All seven primary substations are monitored by UK Power Networks via the installed RTU and have also been included in the analysis below.

Half-hourly load has been extracted from all monitored secondary (kW) and primary substations (MW) from May 2015 onwards and both datasets have been transferred to Element Energy to perform the network modelling. Raw load data for primary substations has also been transferred to Element Energy for cross-checks in case of any undesirable data modification (e.g. data interpolation) performed by the extraction process for the half-hourly sampled dataset.

### 6.3.2 Secondary substations

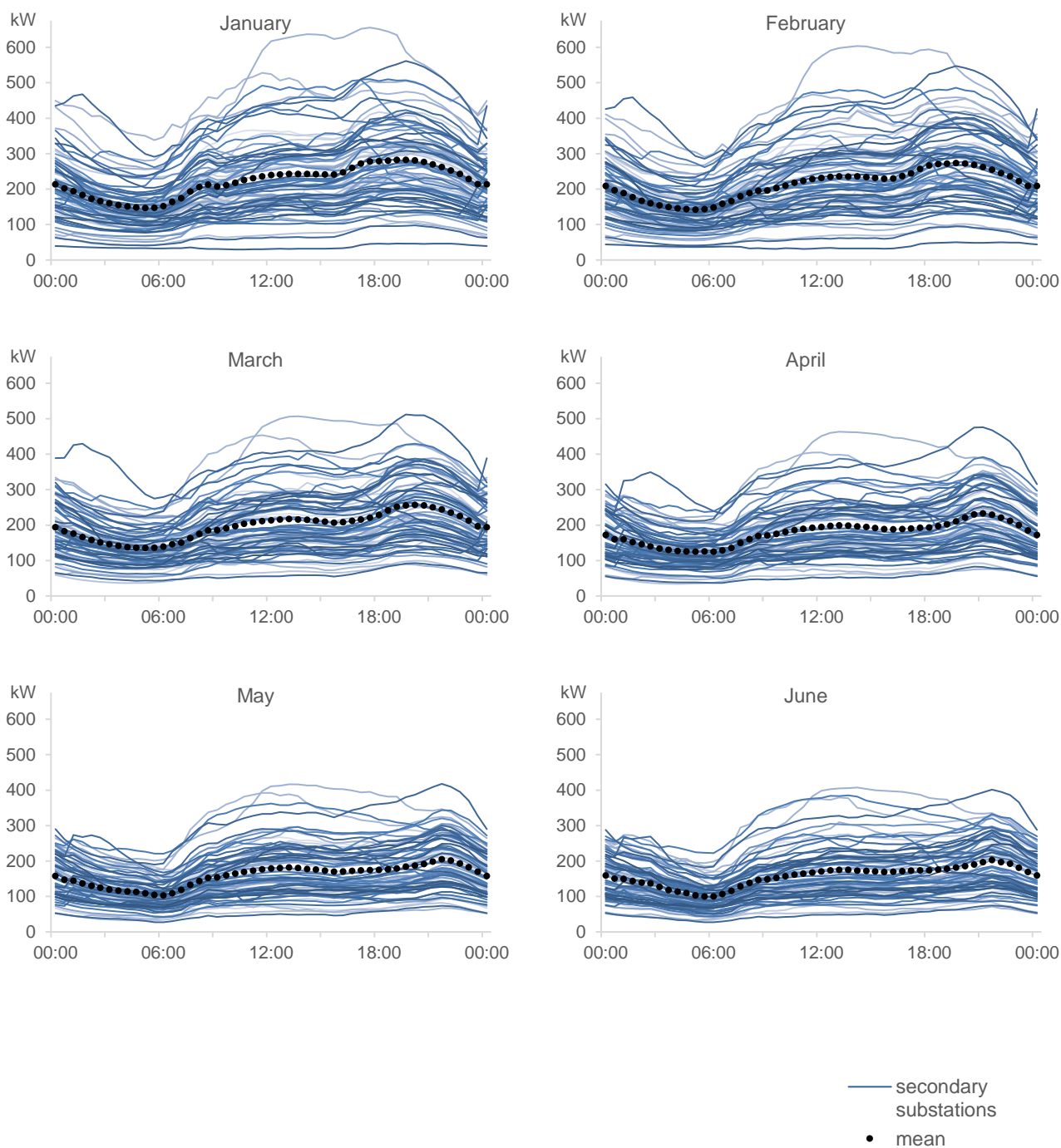
#### Aggregated secondary substation data

For the **energywise** trial, UK Power Networks is monitoring 81 secondary substations associated with the trial. Figure 44 and Figure 45 show the average diurnal load of these secondary substations for the same time period as the smart meter data presented above (15 February 2016 to 14 February 2017).

There is considerable variation in the average diurnal profiles of each secondary substation shown in Figure 44 and Figure 45 due to the unique mix of domestic and non-domestic customers connected to each substation. However, the overarching trend across the secondary substations (as illustrated by the mean secondary substation profile shown in Figure 44 and Figure 45) shows a distinct evening peak and a general profile shape that is broadly comparable to a typical domestic load profile across each of the twelve calendar months. This is likely due to the high proportion of domestic customers (approximately 90% of customer connections) that are connected to the secondary substations associated with the **energywise** trial (i.e. these are secondary substations operating in predominately residential areas). As would be expected from a substation load profile that is largely made up of domestic loads, the evening peak is observed to occur later in the summer months and earlier in the evening during winter months as is typically observed for residential load profiles.

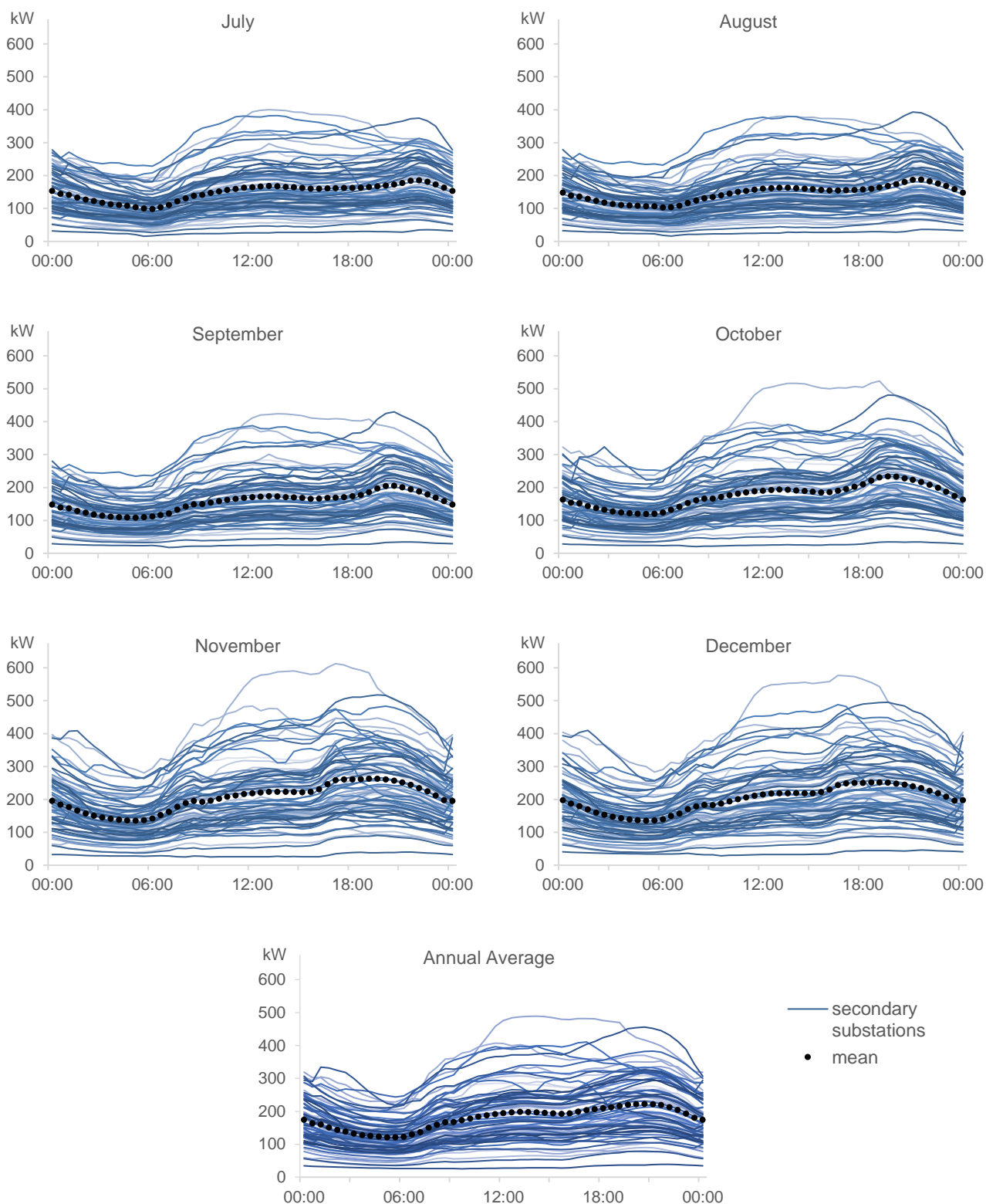


Diurnal load profiles of secondary substations associated with the **energywise** trial



**Figure 44: Average diurnal load profiles of the secondary substations associated with the energywise trial. Loads from up to 81 secondary substations are available (monitored: Feb'16-Feb'17).**

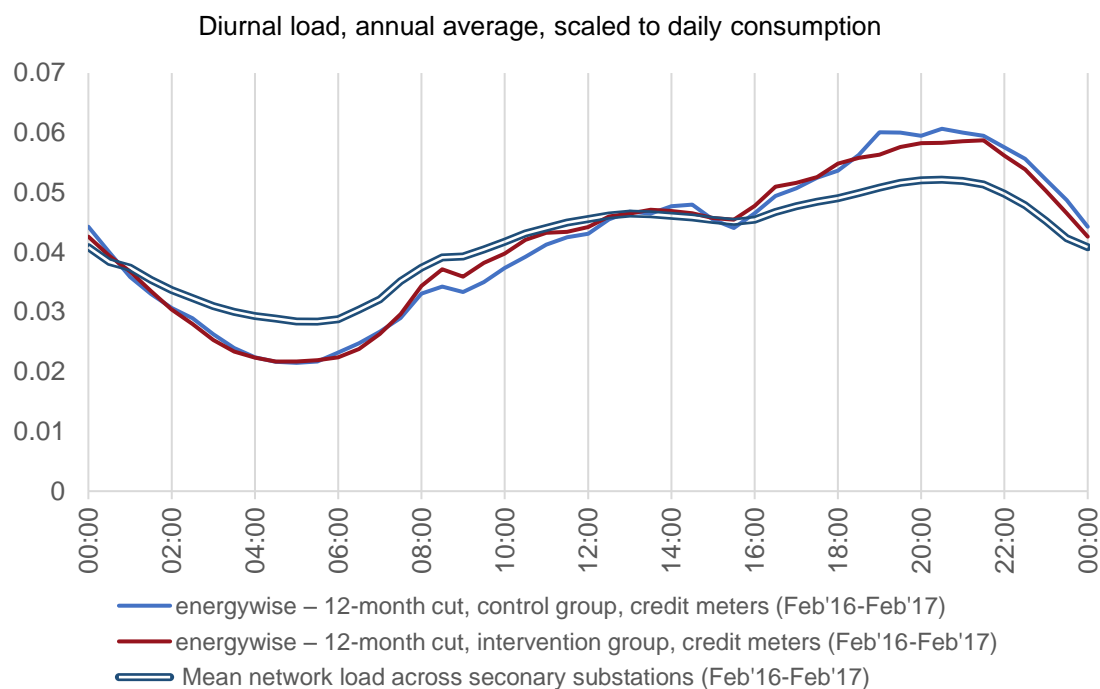
Continued: Diurnal load profiles of secondary substations associated with the **energywise** trial



**Figure 45: Average diurnal load profiles of the secondary substations associated with the **energywise** trial. Loads from up to 81 secondary substations are available (monitored: Feb'16-Feb'17).**

### Correlation of trial impacts with network loads

As can be seen in Figure 46 the peak demand for the **energywise** control group aligns well with that of the mean secondary substation load. By comparing the seasonal variation in the **energywise** participant profiles (Figure 38 and Figure 39) and secondary substation profiles Figure 44 and Figure 45), it can also be seen that the shift in the timing of the evening peak aligns well between the two over all months monitored so far in the trial.



**Figure 46: Comparison of the mean network load of energywise secondary substations with the load profile of the energywise trial participants. In each case, the annual average (Feb 2016 – Feb 2017) is shown. The consumption levels of the energywise intervention and control groups have been calibrated in line with the consumption and savings data reported in Section 5.2.2**

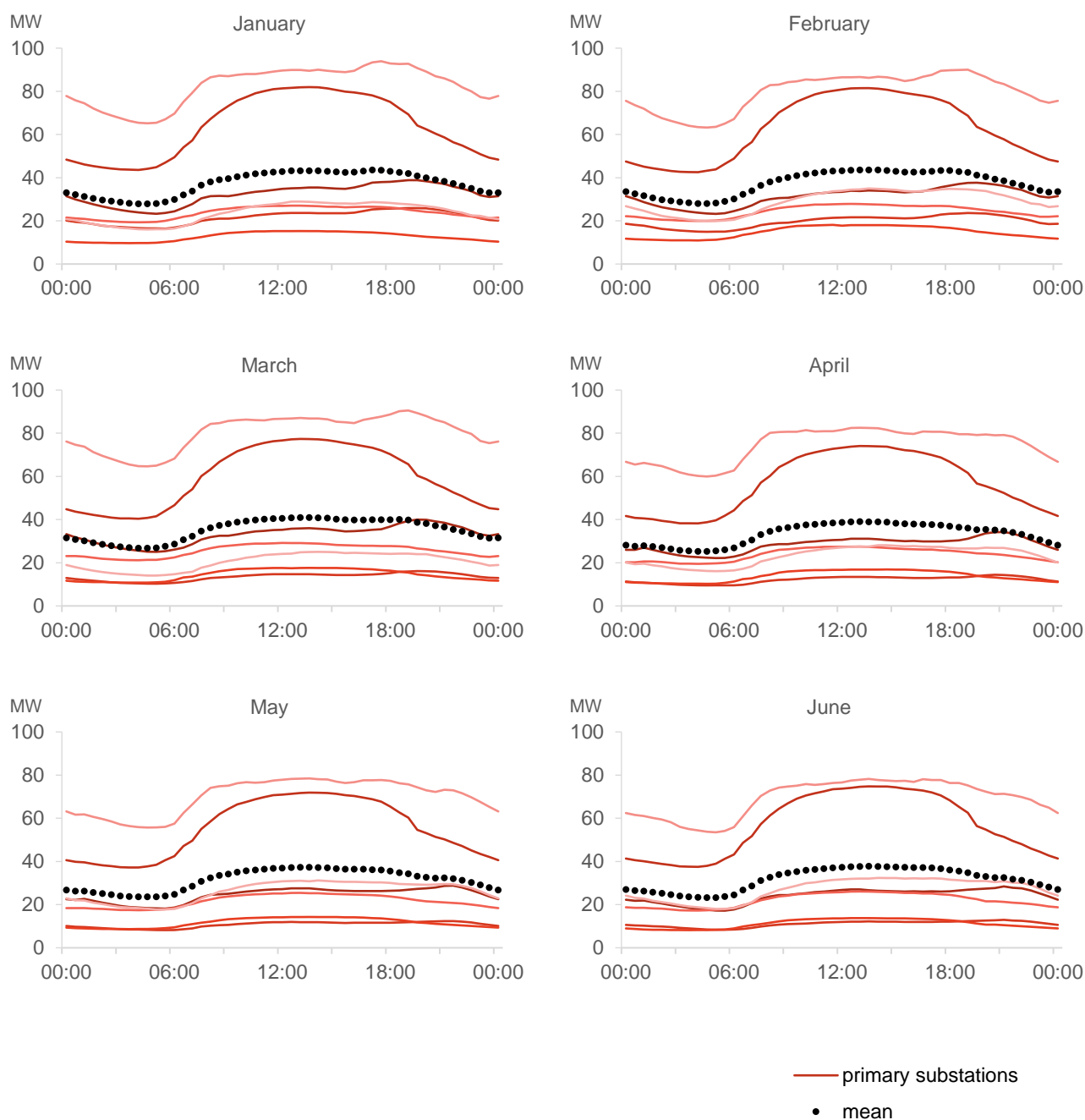
The strong correlation between the **energywise** participant profiles with the mean secondary substation load profiles indicates that the energy saving and peak shifting responses from the trial participants have the potential to directly benefit the secondary substations to which they are connected.

### **6.3.3 Primary substations**

#### Aggregated primary substation data

UK Power Networks is monitoring seven primary substations that are associated with the **energywise** trial. Figure 47 and Figure 48 display the average load profiles of these seven substations (presented in the form of twelve monthly averages) over the same time period that was addressed by the half-hourly monitoring of the **energywise** Trial 1.

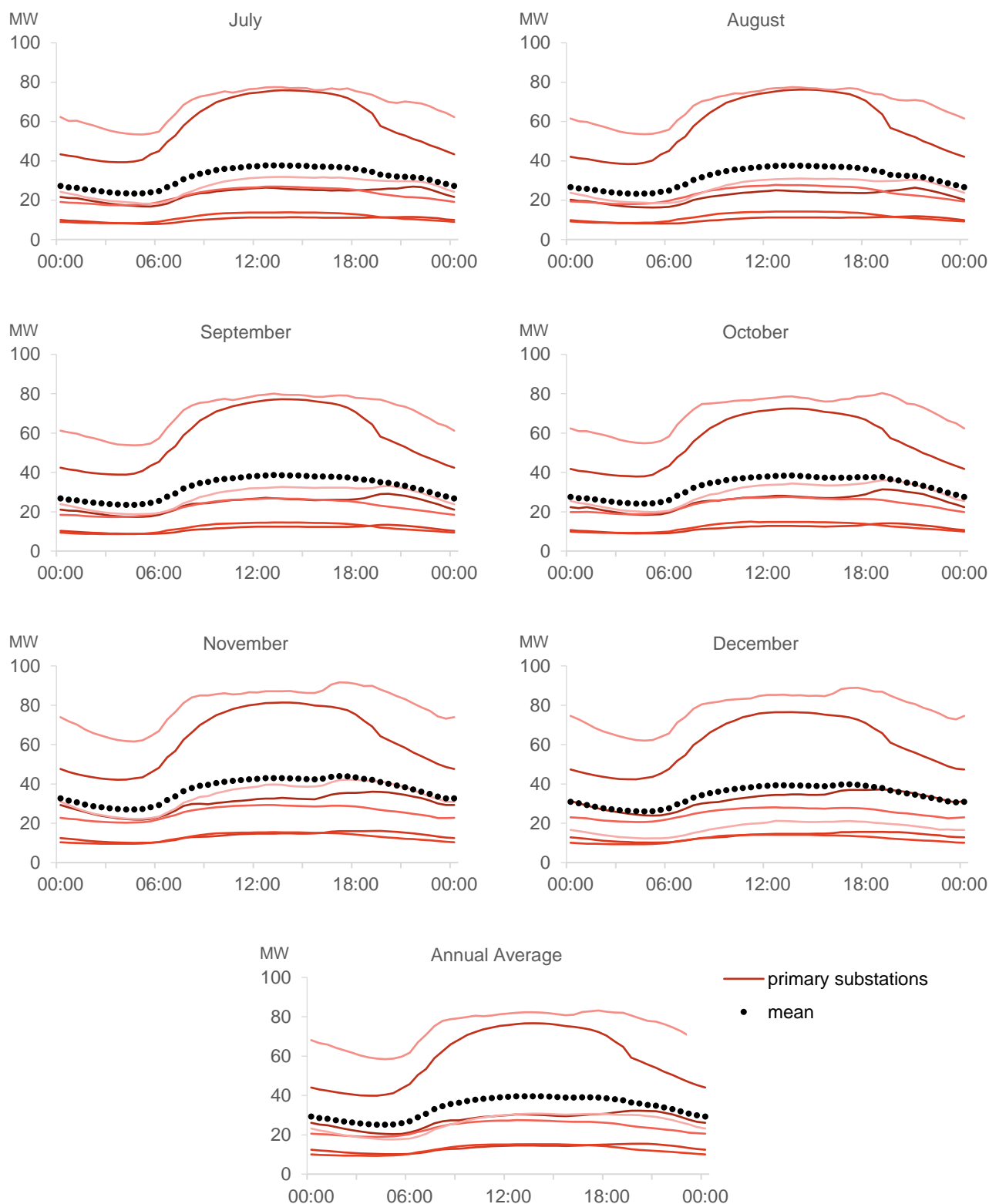
Diurnal load profiles of primary substations associated with the **energywise** trial



**Figure 47: Average diurnal load profiles of primary substations associated with the energywise trial (monitored: Feb'16-Feb'17).**



Continued: Diurnal load profiles of primary substations associated with the **energywise** trial



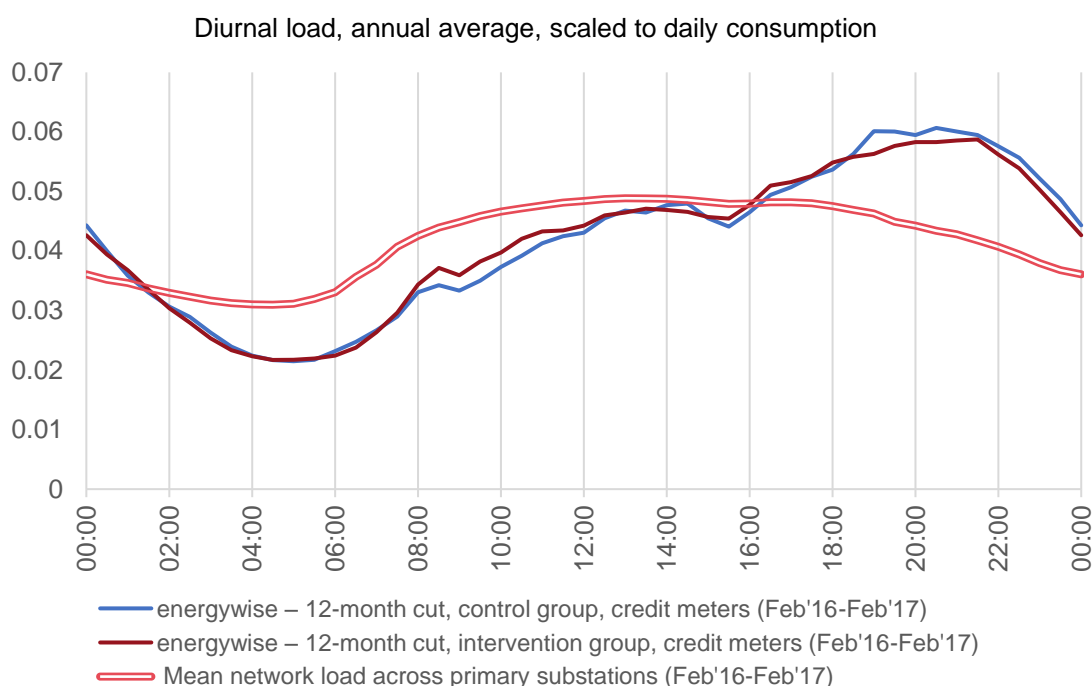
**Figure 48: Average diurnal load profiles of primary substations associated with the energywise trial (monitored: Feb'16-Feb'17).**

As can be seen in Figure 47 and Figure 48, the mean profile shape for the seven primary substations exhibits a much flatter (without a particularly distinctive evening peak) and more seasonally consistent load profile than observed for the secondary substations. This reflects the larger proportion of commercial and industrial loads represented at these primary substations.

#### Correlation of trial impacts with network loads

As can be seen in Figure 49, the correlation of the **energywise** trial participant load profile shape with that of the mean primary substation load is less than that observed for the secondary substations discussed above. This reflects the more diversified nature of the primary substation loads and the higher proportion of industrial and commercial loads (which typically increase loading during the daytime) at this level.

Primary substations will still benefit from wide-scale fuel poor customer engagement with energy efficiency and load shifting interventions, though in the case of the primary substations connected with this trial, the impacts may not align to the substation peak loads as closely as in the case of the secondary substations. It is worth noting that many of the primary substations shown in Figure 47 and Figure 48 have a high proportion of industrial and commercial load, as is common for the areas of London involved in this trial. In the context of broader fuel poor interventions across Great Britain, it may be that other primary substations have a higher (or possibly lower) proportion of domestic load compared to the substations involved in the project and hence greater (or lesser) alignment with the energy savings and demand shifting observed for fuel poor customers.



**Figure 49: Comparison of the mean network load of energywise primary substations with the load profile of the energywise trial participants. Data is averaged over the time period Feb 2016 – Feb 2017. The consumption levels of the energywise intervention and control groups have been calibrated in line with the consumption and savings data reported in Section 5.2.2.**

## 7 Comparison against technical potential

### 7.1 Technical potential trial impacts

To obtain a sense of the scale of energy savings that could be realised in Trial 1 of the **energywise** project, the technical savings potential for each of the Trial 1 intervention devices was estimated. These interventions included:

- Three light-emitting diode (LED lightbulbs))<sup>25</sup>;
- An Eco-Kettle;
- A standby-saver device; and
- The provision of a smart meter and smart energy display (i.e. a real-time display).

It is worth noting that an energy efficiency booklet and support advice were also provided as part of the interventions in Trial 1 of **energywise**. However, the impact of these additional measures is not considered in this technical potential analysis<sup>26</sup>.

The technical potential energy savings for each device were determined using appliance level load profile data from DECC and Defra's Household Electricity Usage Study, household appliance ownership data obtained from the **energywise** Home Energy Survey, real-time display impacts on household consumption from the Energy Demand Research Project (EDRP) and appliance performance data from manufacturers. The estimated technical savings potential during the evening peak (i.e. maximum likely savings that could be realised during the evening peak if each appliance was used as intended) are shown in Figure 50 and are based on the following assumptions:

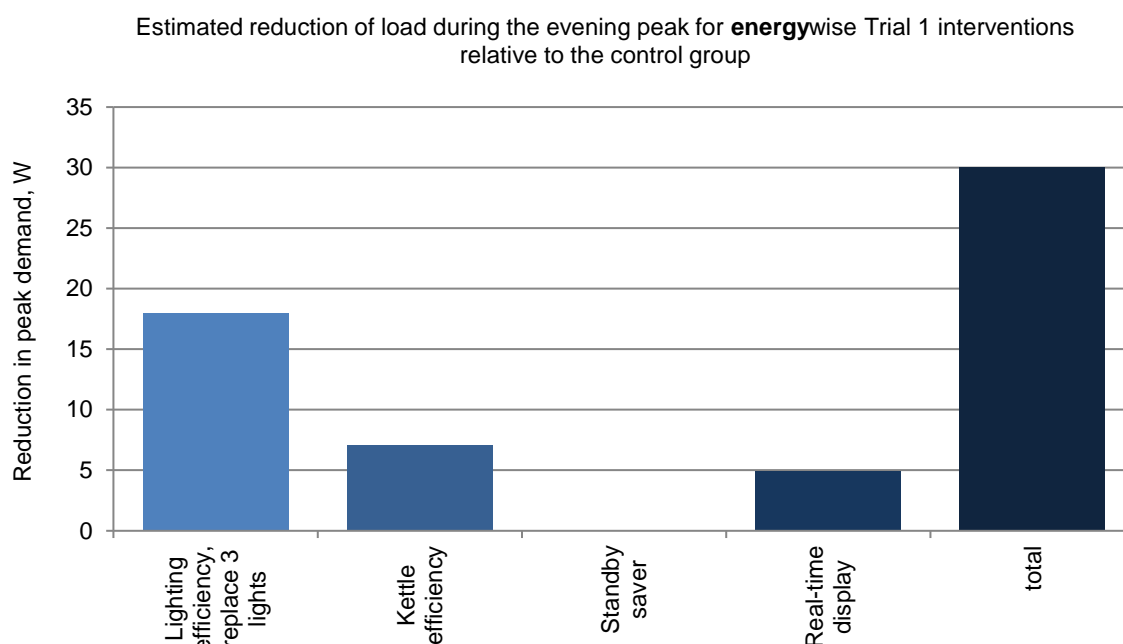
- Three existing lightbulbs (based on the average lightbulb ownership mix reported by **energywise** participants in the Home Energy Survey) are replaced with equivalent LED lightbulbs;
- The primary household kettle is replaced with a more efficient Eco-Kettle;
- The TV and periphery appliances to which the standby saver device is connected are typically in use during the evening peak time window. Therefore, it was assumed that the standby saver device does not contribute to peak demand savings for this analysis (though it would be expected to contribute to overall annual household consumption savings); and
- The consumption savings associated with the provision of a real-time display (in addition to a smart meter or other half-hourly monitoring device) are in line with those observed in the Energy Demand Research Project trials for households with credit smart meters and prepayment smart meters<sup>27</sup>. The project has aggregated the savings levels observed for households with credit and prepayment smart meters using the relative proportion of these two groups within Trial 1 of the **energywise** project and applied the savings to the average annual load profile of the "adversity" smart meter group from LCL.

Early estimates of the technical potential impacts of this trial made use of appliance ownership data from the LCL trial. The technical potential figures reported in this chapter are based on the appliance ownership data reported by **energywise** trial participants in the Home Energy Survey. It is worth noting that relative to the "adversity" households in the LCL trial, **energywise** trial households reported a higher proportion of incandescent light bulbs. The greater incidence of low efficiency light bulbs in **energywise** households increases the potential savings that can be achieved with the introduction of LED lights.

<sup>25</sup> Note that at the end of Trial 1, participants received a fourth LED light bulb. The fourth LED light bulb is introduced as an additional intervention in Trial 2; the additional LED bulb has not been included in any impacts in the Trial 1 technical potential calculations.

<sup>26</sup> The Energy Demand Research Project trials found that there is considerable uncertainty around the impact of energy advice booklets and support advice, particularly in the context of how they interact with various accompanying interventions. Indeed, the advice booklet was reported to not significantly affect consumption in smart meter groups in the Energy Demand Research Project, though this may have been due to competing effects with other interventions: AECOM, "Energy Demand Research Project: Final Analysis", 2011.

<sup>27</sup> The Energy Demand Research Project trial in 2011 reported that real-time displays (in addition to a smart meter) can provide further electricity consumption savings of 1.1% (for households with credit smart meters) and 0.4% (for households with prepayment smart meters): AECOM, "Energy Demand Research Project: Final Analysis", 2011.



**Figure 50: Estimated technical potentials for reductions in peak demand that are possible for the interventions in Trial 1 of the energywise project relative to the control group.**

As can be seen in Figure 50, the total technical savings potential for the **energywise** Trial 1 interventions is approximately 30 W per household during the evening peak. This is an average peak saving over an entire year for a single household that makes use of all the devices provided (relative to the control group). The following section compares this potential with the savings that were actually observed during Trial 1.

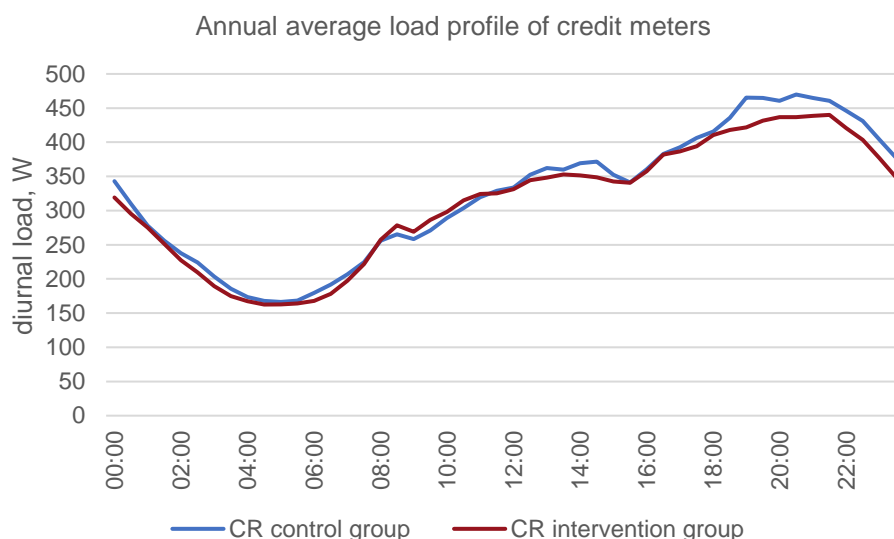
## 7.2 Energy saving impacts observed in Trial 1

Figure 51 displays the savings impact observed in Trial 1 in the context of the half-hourly profiles from Section 6. The average annual diurnal load profiles of the credit meter control and credit meter intervention groups<sup>28</sup> are scaled to the annual consumption derived in the DiD analysis from Section 5.2.2 (representing a savings impact of 3.3% in annual consumption, which has been derived from daily smart meter data across all meter types). The diurnal load profile (annual mean) of the control group maintains an average of 443 W during the evening peak window, which is defined from 17:00 to 22:30<sup>29</sup>. The corresponding average peak load of the intervention group amounts to 420 W, which equates to an average reduction of 23 W, equivalent to a reduction of 5.2% (see Figure 51).

<sup>28</sup> It was not possible to produce the savings impact of the prepayment customers as a separate output at half-hourly resolution as there was no half-hourly smart meter data available for the prepayment intervention group during Trial 1. Rather, the aggregated annual savings effect observed across all meter types (as defined in 5.2), is shown with the help of half-hourly credit meter smart meter data.

<sup>29</sup> This peak window is consistent with that used in the Low Carbon London trials.





**Figure 51: Annual savings impact on average annual load profile observed for credit meters during Trial 1. The consumption levels of the intervention and control groups have been calibrated in line with the consumption and savings data reported in Section 5.2.2.**

The actual average peak reduction realised in Trial 1 (23 W) is slightly smaller than the calculated technical potential for peak reduction (30 W) from this trial. This is as expected as not all appliances were used by each household, and in some cases, they were used in a non-optimal manner (see the qualitative insights in Section 5.5). Nonetheless, the savings observed in the trial are promising relative to the calculated technical potential and reflect the capacity for meaningful engagement with energy savings in the trial participants.

### 7.2.1 Potential network impacts associated with the savings observed in energywise Trial 1

The potential network impacts that could be achieved by rolling out **energywise** Trial 1 interventions across all fuel poor customers in the UK Power Networks licence areas is estimated in this section. The calculations in this section make use of geospatially resolved data from the Department for Business, Energy & Industrial Strategy “Fuel poverty sub-regional statistics”<sup>30</sup> on the percentage of households classified as fuel poor to determine the number of fuel poor customers that are served by UK Power Networks (based on the Low Income High Cost classification).

Table 8 summarises the network impacts that could be achieved if the **energywise** Trial 1 energy savings were realised by all households classified as fuel poor within the UK Power Networks licence areas. In total, an estimated annual reduction in electricity consumption of 56 GWh could be achieved across the three licence areas if the same interventions were provided to all households classified as fuel poor within UK Power Networks licence areas. This corresponds to an average reduction in the evening network load of approximately 14 MW.

<sup>30</sup> Department for Business, Energy & Industrial Strategy: “Fuel poverty sub-regional statistics”, available from <https://www.gov.uk/government/collections/fuel-poverty-sub-regional-statistics>. Data is provided at LSOA resolution (Lower Layer Super Output Area).

**Table 8: Potential network impacts associated with energywise Trial 1 savings.**

Licence area	Number of fuel poor customers in license area	Reduction in annual electricity demand	Reduction in network load during evening peak (17:00-10:30)
		GWh	MW
Eastern Power Networks	281,382	26	6.5
London Power Networks	162,496	15	3.7
South Eastern Power Networks	160,939	15	3.7
<b>Total</b>	<b>604,817</b>	56	13.9

## 8 Insights on customer protection

### 8.1 Introduction to customer protection strategy

Given the project's objective of involving vulnerable customers, it is important that protections are in place to ensure that the project follows the principle of 'do no harm' in terms of its participants.

The project's Communications Plan made the following commitments related to customer protection:

- Procedures for handling complaints and enquiries; systems are in place to ensure that any complaints or enquiries are dealt with promptly by the appropriate partners (Sections 8.1.2 and 8.1.3);
- Vulnerability; once participants have consented, they will be surveyed about their personal circumstances to provide the project with greater confidence about their suitability to take part in the project. Customers who are blind or visually impaired will not be able to take part in the project, as there is at present no IHD suitable for these customers. Those who are most vulnerable to suffering as a result of short term power outages, i.e. those dependent on electrically operated medical equipment, will also not be eligible to take part in the trial. This is discussed in Section 8.1.2 below;
- Participant wellbeing; the temperature of customers' homes is being monitored to ensure both that the project does not adversely affect participants as a group, and also to flag up any dangerously low temperatures in the homes of any participant. Further information on this is provided in 8.3;
- Work affecting participants' power supplies; where smart meters are installed, energy supply is turned off during installation for around 30 minutes. As anticipated, the project has not necessitated any interruptions to supply associated with work on the distribution system; and
- Safety; installations of all equipment complies with British Gas' Smart Meter Customer Charter and all relevant licence conditions. British Gas' Smart Energy Experts carry out risk assessments before starting any work at a customer's home and carry out safety checks as necessary. All equipment provided is CE marked.

This section focuses on the procedures that have been put in place to ensure participant wellbeing.

#### 8.1.1 Handling complaints and enquiries

Since March 2016, Bromley by Bow Centre has maintained an electronic complaints and issues log, which records, by customer, any query or issue that arises, with information on the action taken, mitigation plan and progress status. Prior to March 2016, issues were passed directly onto project partners as required without being captured in a central log. It was recognised that this was not ideal which is why this central record has been put in place.

As of April 2017 this log had issues recorded by 21 customers, including for example:

- Instances where CFOs organised to replace participants' equipment that wasn't working or which the customer reported having not received;
- Disengaging a customer from the project because they moved to a different property;
- Chasing up an outstanding installation appointment on behalf of a customer;
- Logging the fact that one participant will be temporarily decanted from their property while work is carried out;
- One complaint about damage to a furniture unit from the Passiv temperature sensor (This issue has been resolved to the participant's satisfaction);
- One customer who wanted to register with the project the savings he could make by switching to a different supplier (This participant has since switched supplier and is no longer part of the project);
- Three prepayment customers initially reported delays with the vending process for their meters (all of whom were referred to British Gas to follow up);

- Instances that had been referred to the Disclosure Board for consideration (see Section 8.1.3 below) since they concerned either participant or customer safety; and
- Instances that had been logged on the Vulnerability log for discussion via that forum (see Section 8.1.2 below).

### 8.1.2 Vulnerability

In identifying customers eligible to be invited to take part in **energywise**, those known to the social housing associations and to British Gas to be most vulnerable to suffering detriment as a result of participation in the trial were removed from the list of eligible participants. These included:

- Those dependent on electrically operated medical equipment) were not invited to take part;
- Those who are blind/visually impaired (since no IHD suitable for the visually impaired was available);
- Those in debt to British Gas; and
- Those who were highlighted as “seriously ill”, or “confined to bed” were also excluded.

The project recognised that not all required information, particularly related to the vulnerability of households, would be readily available at the time of identifying and selecting the trial participants due to knowledge gaps. However, the project incorporated a customer-oriented approach and a team of CFOs were dedicated to the continuous engagement with the trial participants. Where the CFOs identified that a trial participant was more vulnerable than initially realised, they had the capability to assess their situation and make recommendation on the appropriate course of action. If someone was identified as ‘too vulnerable’ to participate in the project whilst having been enrolled in the project, the CFO would have made the recommendation to the project team on the condition of the customer and should it is deemed suitable, the customer would have gone through a disengagement journey out from the project.

Following recruitment, once trial participants had given consent to share their data within the project partners, the project performed additional checks on the vulnerability of each recruited household in order to ensure that their status as known by the project has not changed over time. Individual organisations such as the social housing providers, British Gas, UK Power Networks and Bromley by Bow Centre have provided any vulnerability status recorded in their databases associated to the recruited households.

Bromley by Bow Centre has acted as data aggregator and first reviewer classifying each household under one of the following categories:

- **Green** – lowest level of risk to customer related to involvement in trial (e.g. where the only vulnerability flag is that there is someone under 16 on the trial, or someone over 60, or where they have mobility issues or are hearing impaired); .
- **Amber** – medium level of risk. This may include those categorised as 'mental health issues' or 'long term illness'. Some of these may be categorised as green based also on the CFOs' observations); and
- **Red** – high risk. Red would include anyone who is blind/visually impaired, dependent on electrically operated medical equipment, or where there is a concern that the customer could not have given informed consent due to learning difficulties or mental health issues.

A first assessment conducted in May 2016, which included both the vulnerability flags provided by each organisation and the observations from the CFO team, has identified eight households considered at high risk (**red**) and seven at medium risk (**amber**) out of those still participating in the trial.

The outcome of the preliminary review has been shared with any relevant partners (the social housing providers, UK Power Networks, British Gas, University College London, Bromley by Bow Centre and CAG Consultants) in double-anonymised form (i.e. without using the project's unique ID but simply adopting a numbering convention, e.g. customer 1, 2, 3) and a group review has been performed for those households identified under the Amber and Red categories who are still participating in the trial. As a result of this group review:



- Two Amber households identified as having medically equipment in their home were upgraded to Red (making total of ten high risk households);
- Eight of the high-risk households have medically operated equipment. Whilst it was stated that such households would not be included in the trial, project partners are in agreement that it would be better for these households to stay in the trial than to be disengaged, as there is no greater risk to them of losing electricity supply; indeed, they will be afforded better protection through being in the trial. It is therefore planned to keep them in the trial but ensure the CFO team and other partners are aware of the need to be very sensitive in their dealings with these customers, for example in terms of signing them up to the ToU tariff or asking them to complete surveys;
- The other seven households were agreed to be low risk and will remain in the trial. These included two households where there is someone who is blind or partially sighted within the home; these will be kept in the trial as the person signing up to the trial was seen by the CFOs as being able to read the information provided and therefore should not have any problem with using the energy display; and
- Two of the 15 red households are on prepayment meters. Given their highly vulnerable status, British Gas, in line with their BAU activity, will contact these customers and offer to switch them to credit meters. If they do choose to switch, they will remain in the project but their data will not form part of the Trial 1 data analysis (since they would be ineligible due to having changed meter types). However, it will be possible to include their data in the Trial 2 analysis (assuming they choose to sign up to the ToU Tariff).

A revised vulnerability review was started in December 2016 and completed in May 2017. This found that:

- Seven households were identified as high risk (i.e. blind/visually impaired, dependent on electrically operated equipment, or where there is a concern that the customer may not have given their informed consent due to learning difficulties or mental health issues), of whom:
  - Four were identified as high risk in the May 16 review; and
  - Three were previously categorised as low or no risk (and have therefore not been discussed previously).
- Seven were categorised as medium risk. This may include those categorised as 'mental health issues' or 'long term illness', of whom:
  - Three were flagged as medium risk in the May 16 review; and
  - Four were previously flagged as low risk.

As per the assessment conducted in May 2016, the project partners are currently performing a group review to decide whether those households identified at high or medium risk can still participate in the trial.

Additional procedures that are in place to ensure safeguard for those that are most vulnerable include a password scheme operated by British Gas for its PSR customers.

Also before the commencement of recruitment activities the customer CFO team have been through a Disclosure and Barring Service (DBS) check and two members of the current team have received training from National Energy Action in identifying vulnerability. This covered: defining and identifying vulnerability; the potential impacts of vulnerability; identifying fuel poor households; and sources of help and support for fuel poor households.

Of the 538 customers that signed up to the project, 12 made requested special arrangements, the majority of which (nine) involves requesting interaction with a CFO who spoke Bengali. This is in line with the HES findings showing that first ethnic group in the sample population (out of those who returned the survey) is Bangladeshi, with Bengali being the most common first language together with English (see Section 3.4), and it demonstrates the importance of having a local team with language skills close to the ones of trial participants. One requested assistance from a CFO in completing the ESC survey, another requested to be visited only from a female recruiter and another requested that only a specific recruiter visits.

These arrangements have been recorded to ensure a high level of customer service. Provision was made to provide customers with communication materials in alternative formats to suit their needs; no request for this has been made to date.

In addition, two key mechanisms have been developed to protect vulnerable customers – the disclosure board and the temperature monitoring protocol, both of which are outlined below. A participant panel has also been set up to provide general ‘health check’ on the project and enable regular, structured feedback from a group of participants which may include customer protection issues.

### **8.1.3 Disclosure Board**

The disclosure board is an important project control mechanism in relation to customer protection, which provides an escalation route for the CFO team in relation to safeguarding items observed while interacting with the households and a mechanism for the project partners to obtain decisions on best course of action aiming to maximise the safety both to customers and the CFO team.

Within the installation phase, three disclosure boards had been held aiming to address matters that arose from the installation appointment booking process or during the installation visits.

The first two boards had been requested and chaired by UK Power Networks under exceptional circumstances as they identified specific circumstances that required the attention and prompt decision of the disclosure board. UK Power Networks has handed back chairing activity to Bromley by Bow Centre for escalation protocols and in the administration of the board as per the agreed disclosure board terms of reference and a refresher on the disclosure procedures has been also provided to the CFO team.

Seven cases were addressed at the disclosure boards held in 2015, including for instance:

- A customer that turned to the project to get support to resolve a technical issue with a faulty gas boiler;
- A vulnerable customer with carer;
- A broken item found by a customer post installation visit; and
- An elderly customer has had their gas supply capped due to faulty cooker identified during project installation.

A further two cases were addressed at disclosure boards held in 2016 and the early part of 2017. These aimed to address matters that arose from high risks identified through the temperature monitoring and in relation to Trial 2 recruitment. In both cases, the customer was followed up by their Social Landlord as a broader “customer care” action.

In each case the suitable resolution process was discussed and agreed by the disclosure board. For example, the case of the elderly customer with faulty cooker was treated with highest priority as the customer was identified as vulnerable. Local partners identified support programmes the customer could have been referred to and with the support of an East End Energy Fit project advisor the customer was awarded £200 crisis and support grant to replace the faulty cooker.

Dependent on the seriousness of the case, the participant may be removed from the trial so that they can receive appropriate advice and support. To date no participant has been identified 'too vulnerable' to take part in the project as part of the Disclosure Board process. Those leaving the project would receive a leaving pack including the Consumer Services Charter (Figure 52) providing advice and signposting to local and nationally available services relating to reducing energy costs. Where possible, it is also envisaged that they would be referred to other services as appropriate.

### Learnings

As a result of the learnings from the operational phase of the project, the terms of reference of the Disclosure Board have been reviewed by Bromley by Bow Centre. It was observed during the installation phase of the project that a faster and more direct escalation protocol may be required in specific circumstances (e.g. in case of technical matters). Also at the evaluation workshop in May 2016 partners agreed that the Disclosure Board was being used to consider too wide a range of issues, and should focus back on its primary objective of dealing with issues that affect the safety of either participants or CFOs. It was agreed that the complaints and issues log should be used to record all issues raised, and only those issues relating to safety should be escalated to the Disclosure Board, at the decision of the customer field officer manager.

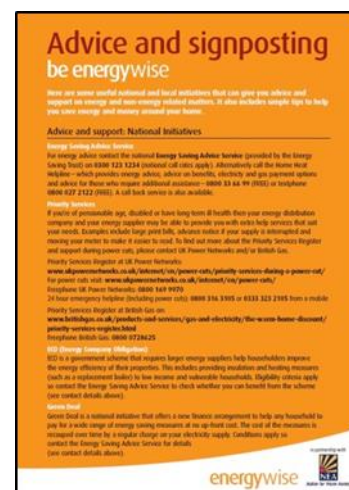
Therefore, the following changes have been finalised by the CFO manager in May 2016: three separate protocols have been developed depending on the type of issue the CFOs are facing:

- **Technical Issues:** this protocol provides a simple and clear process to follow should the CFO receive a call pertaining to a technical query, with clear indication on what issues the CFOs can resolve, and what issues have to be escalated to a third party. It aims to facilitate a quick and satisfactory resolution, ensuring a fully transparent audit-trail where needed.
- **Customer issues and complaints:** this protocol provides clear guidance to the CFOs on how to capture and effectively manage any issue/complaint raised by a trial participant in a timely manner. It also clarifies at what point matters are to be escalated and shared with other project partners.
- **Disclosure Board (sensitive issues):** this reflects the original scope of the Disclosure Board, where a matter of a sensitive nature become known to the CFO, or the CFO is subject to abuse, racism, etc. by the customer. The purpose is to ensure safety of CFOs and project participants and it aims to establish clear protocols so any matter can be escalated immediately to relevant bodies such as the police and/or the social landlord, and to project partners so action can quickly be agreed.

## 8.2 Customer panel insights

Two participant panels have been established, which meet regularly over the course of the project. In Trial 1 participants were split in two panels depending on their group allocation, while in Trial 2 based on their meter type. The purpose of these panels is to provide a structure for participant feedback and a sounding board for participant views. Each panel has 6-8 participants.

Membership is open to all **energywise** participants, with information on applying to join the panels contained in the welcome pack. In addition, the project team actively targeted at recruitment at selected participants to ensure that the membership generally reflects the geographical spread and demographic makeup of the research participants as a whole. Participants are offered £30 in vouchers for each panel attended, as a thank you for their time. Each panel is attended to have around 6-8 participants; for the inaugural panel meeting in March 2016, there were six participants at each panel.



**Figure 52: Consumer services charter**

Panel meetings were initially facilitated by staff from CAG Consultants, with this role being handed over (following appropriate training) in early 2017 to Bromley by Bow Centre, with a researcher from University College London observing and taking notes. The **energywise** CFO team organises and attends the meetings.

The inaugural panel meeting (Panel 1) was reported in the original SDRC 9.3 report. Since then, a further three panels have been held and will continue to be held every three months until the end of the project

### 8.2.1 Key findings

It should be noted that nothing has been raised at any panel meetings regarding any customer protection issues.

#### Panel meeting 1 – March 2016

The inaugural panel focused on gathering participant feedback on the recruitment and installation process.

##### Recruitment:

- There was consensus amongst participants that the **energywise** letter was necessary to make people aware of the project and the fact that they'd been selected to participate. Some felt that a letter which emphasised the British Gas connection, making it very clear that the letter wasn't about switching energy provider, would have increased confidence/interest. The explanation of the project by the CFO was key to understanding the project and joining, and all participants were very positive about the CFO team.
- One participant felt strongly that door knocking visits should not be made after 5pm and said that door knocking from two men could be intimidating to some. Several felt comfortable discussing the project with women. Some were attracted by the feeling of being 'selected'; the fact that the project was not open to all. Participants liked the fact that appointments could be fitted in around personal schedules.
- The main motivations to take part were the potential to save money and the offer of vouchers.
- There were suggestions that the recruitment materials could be a little simpler, whilst some of those in Group 2 felt strongly that it was important for them to be aware from the outset that there were two groups and this should have been made clearer at the point of recruitment and in the information.

##### Installation:

- Most felt the installers were good and were happy with their contact with them. There was a general consensus that the installation team was very good and made the process easy, although two participants had had problematic installs and most had had post-install visits to rectify issues such as temperature sensors falling off the wall. In general, this did not seem to have generated much ill-will. It was felt it would be good for there to be more flexibility in how the kit could be installed in the home to work with individual preferences and situations.
- There were some low level concerns about the technology and how much to interact with it.
- Participants weren't asked for their views on the IHD or energy saving kit; this will be covered in subsequent panel meetings.

##### General communication:

- Participants were positive about the communication they get from the project and about the CFO team.
- The books of stamps sent with the surveys are very popular and seen as being a good and novel way to encourage participants to return their survey.
- Participants were positive about the panel and all were keen to be involved in future meetings.
- A participant said: *"I was nervous about coming to the panel, as I'm not someone who likes speaking out, but I enjoyed the process and I'm more confident about it now."*



### Panel meeting 2 – July 2016

At these meetings, it was identified that:

- The control group expressed a degree of dissatisfaction with their **energywise** experience to-date and/or were a little confused about the project. The core reason for their frustration was the fact that they had not yet received their energy saving devices. Several in this group had also had some problems with their temperature monitoring equipment and some were dissatisfied with this.
- The intervention group were in general happy and excited to be part of the project. They were positive about the communication they received and, whilst they reported some problems with their temperature monitoring equipment (most had had one visit to rectify problems), these were presented more positively than in the control group. There was some confusion about how to use the smart energy display and the standby saver and some participants were finding it difficult to use their eco-kettle. All participants were keen to receive guidance and tips on how to best use their equipment.

As a result of the feedback received at this panel meeting,

- The delivery of devices to the control group was brought forward to before Christmas 2016 (see lesson 4.3).
- The newsletter was changed so that there is a different version for each group:
  - The intervention group will get some tips about their devices; and
  - The control group will get a clearer idea of when they can receive their devices.

### Panel meeting 3 – November 2016

At this meeting, the control group were found to be happier with the project than at the previous meeting (possibly as a result of the communication about the delivery of the energy efficiency devices to control group starting in November 2016), and reported feeling well-informed, connected to the project and excited about receiving their energy saving devices:

- The new design kettle, which was demonstrated at the meeting, was very popular and well-liked, as were the LED bulbs.
- Demonstrating the standby shutdown helped people fully understand the benefits of using it, and some said they would use it. Generally, it's not seen to be as useful as the kettle and bulbs as it's not relevant to all customers (e.g. those who never leave things on standby).
- Some participants reported ongoing problems with the temperature sensors, e.g. falling off the walls (see lesson 3.1).

The intervention group were also generally happy with the project and were happy with the level and format of communication they were receiving from the project. Some participants reported similar problems with the temperature monitoring equipment whilst others had problems with their smart energy displays. Some were also having problems with their kettle for example reporting problems with it not turning off, or finding it too heavy. The LED bulbs were well received and liked.

As a result of this meeting:

- A December newsletter was organised to provide updates on project, and information on the new tariff, with links to online tutorials for the kettle and standby shutdown.
- The strategy of not initiating further action on temperature sensors was maintained, with participants reassured that it was fine for them to simply place fallen-off sensors somewhere sensible, such as a shelf or table.
- Participants experiencing problems with their kettles were provided with replacements.

### Panel meeting 4 – January 2017

At this (and subsequent) panels, participants were split by meter type (as this will determine their Trial 2 offer) rather than by intervention or control group.

The credit group were in general positive about their experience of **energywise** and have engaged with the project by using their devices and reading the newsletters. They gave positive feedback on the time of use tariff offer for credit customers, and useful feedback on communication materials (including showing potential savings).

The prepay group were also positive about their experience of **energywise** and have engaged with the project by using their devices and reading the newsletters. All were positive on the proposed DSR offer for prepay customers. Useful feedback on the communication materials including information on how participants will be informed of the savings they have made, and the need to emphasise that the offer doesn't relate to gas.

As a result of this meeting:

- Participants' feedback and insights were used in the field officer Trial 2 training session held in January 2017;
- Communication materials were amended in line with the feedback provided;
- The Trial 2 offer for prepay participants was named Bonus Time (rather than 'Save 1 Get 10 Free'); and
- The 'frequently asked questions' document used by British Gas and the customer field officers to recruit participants onto Trial 2 was amended to include answers to concerns or queries raised at the panels, including potential confusion related to energy saving project offering a free electricity tariff.

#### Customer protection issues

Nothing was raised at any panel meeting regarding any customer protection issues. The customer field officers followed up with customers where individual problems were identified such as faulty kettles (which were replaced). British Gas followed up with customers experiencing problems with their smart energy display and with topping up. The general reassurances that were asked for in the panel groups were conveyed to the rest of the participants through the project's newsletters and adjusted processes.

### **8.3 Insights from participant interviews**

As part of the evaluation of the **energywise** participant recruitment, telephone interviews were held with a randomly selected sample of 30 participants. A second round of telephone interviews were held with 25 participants following the recruitment onto the DSR tariff. This exercise was proven effective in terms of customer protection to pick up uncovered problems that participants hadn't proactively reported to the **energywise** team. For instance:

- In Trial 1 some of the prepayment customers reported they experienced some delays when topping up through the Smart Energy Display with credit not showing up immediately on their meters (see Section 5.5.4). A British Gas investigation proves there has been little contact from these customers regarding this matter, suggesting the importance of having in place different customer engagement channels particularly for projects targeting this segment of population.
- In Trial 2 some of the prepay participants were confused about how the DSR trial worked, with one participant incorrectly thinking they should be increasing, rather than decreasing, their electricity consumption during the DSR events. As a result, further clarification was provided to all participants via text, letter and telephone calls.

### **8.4 Temperature monitoring**

A key component of the project's approach to customer protection is the monitoring of temperature in participant's homes. Whilst the homes on the trial are all gas heated, there was qualitative evidence presented earlier in the report which shows that additional electric heaters are in use in several homes, and people's usage of them could change as result of the trial. There was a wider concern that people may be confused with the messaging and seek to make savings by turning their gas heating down. For this reason, the project instituted a process of monitoring temperature in the home as an early warning sign.

#### 8.4.1 Temperature monitoring protocol

Through a series of workshops, project partners have jointly developed a protocol for monitoring the temperature of customers' homes and for taking action where necessary. Temperature is being monitored for:

- 'Trial effects' – to test whether participating in the trial is reducing internal temperatures in participants' homes to potentially dangerously low levels (and hence potentially resulting in negative health effects) as a result of the trials; and
- 'Condition effects' – to determine if participants are experiencing dangerously low temperatures in their homes as a result of their living conditions (independently of any effects of the trial).

Two remote temperature loggers have been installed in the homes of all trial participants at the same time as the smart meters/data loggers; one in the living room and one in the bedroom (see Figure 53). These record temperatures at regular intervals.

University College London receives a monthly data file from Passiv/British Gas providing temperature data for both rooms. In addition, Passiv produces a daily report on homes where the temperature has dropped below a certain point for three consecutive days, as per the thresholds listed below. These thresholds were agreed with partners, based on 1987 guidance from WHO on the health impacts of low indoor temperatures<sup>31</sup>.

The action depends on the effect observed, as explained below:



**Figure 53: The temperature monitoring equipment**

##### Trial effect

In the event of a significant difference in temperature being observed between the two groups, the action will be to send all participants (in both groups) an energy advice leaflet which provides information about how to economically heat their home and information on where to go for further help or advice.

##### Condition effect

In deciding the appropriate action to take in terms of the trigger point being reached in individual households, consideration will be given to the following issues:

- The level of risk to the householder (e.g. were they at home when the trigger point was reached, are they vulnerable to suffering ill health due to low or high temperatures);
- What the appropriate action would be (i.e. what help can be offered). This may include a home visit by one of the field officers, and/or referrals to advice agencies; and
- Whether this action would necessitate the participant being removed from the trial.

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<sup>31</sup> WHO (1987) *Health impact of low indoor temperatures: Report on a WHO meeting*, World Health Organization, Copenhagen.

#### 8.4.2 Resolution of temperature logger issue

The project has experienced a number of customers whose temperature monitoring data has not been returned to PassivSystems. This is due to a mix of technical and behavioural reasons. The temperature monitoring equipment must remain powered on and connected to the internet in order to return data (please see Section 9.7 for lessons learnt). 381 customers were installed with temperature logger equipment, of these a total of 275 had missing data alarms activated between February and June 2016.

On 16 February 2016, a corrective action plan commenced to resolve some of the missing data. Bromley-by-Bow centre issued a project letter provided by British Gas to the 238 affected households, asking customers to reconnect their devices and giving clear visual instructions on how it should look. This was then followed by a door knocking activity by Bromley-by-Bow Centre where 237 properties were visited (as 1 household resolved the temperature sensor alert issue upon receipt of the letter) ; of which 103 customers were available (43%) and 134 were not available (57%). This activity was followed by outbound calls to the customers: 119 customers were called; 54 customers answered these calls (45%) and 65 did not (55%). The objective for both activities was to correct customers' equipment on site or raise an engineer home visit where required.

3% of the alerts (eight households) were resolved by the customers following the receipt of the letter; considering those interactions where the customer has been reached. 30% of the door knockings (31 households) and 4% of the outbound calls (two households) resulted in the resolution of the alerts. A total of 107 engineer visits were arranged, of which 99 were successful in reaching the customer which resulted in 86 visits successful in restoring sustained communications (87% of the visits attended by the customers) as illustrated in Table 9.

Due to the volume of customers not returning data and reports highlighting repeated loss of data communication following a successful visit, a second wave of remedial visits was planned and undertaken from 16 May 2016 to 17 June 2016. Again, the aim of this exercise was to maximise data collection from temperature monitoring equipment by resolving equipment alarms shown on the alarms reports from PassivSystems. Please refer to Table 9 below for a high-level analysis of each intervention method.

- 174 trouble shooting **letters** were sent via second class post on 5 May 2016, 173 were delivered with one being returned to sender. The letters generated a total of 11 participant resolutions (6.36%).
- For those participants not responding to these letters, Bromley by Bow Centre opted to approach participants via **outbound calls**, rather than door knocking. Bromley by Bow Centre recommended to prioritise outbound calls first as this is a more time effective way of getting hold of a large number of participants once they are already engaged onto the project. Door knocking will then be used to target those households that are hardest to reach. Outbound calls were performed from 16 May 2016 to 10 June 2016 to 165 participants resulting in 132 successful interactions; a response rate of 80%. Of the 132 interactions 12 (9.09%) alarms were resolved through outbound calls.
- **Door knocking** activities in the second wave commenced once three attempts to outbound call participants had been made. This activity began on 18 May 2016 and ended on 27 May 2016. 73 door knocks were performed, successfully interacting with 21 participants (29%). One participant alarm was successfully resolved via this interaction method (5%).

Following all interactions, a total of 140 PassivSystems engineer visits were booked in the second wave, of which 114 of were met by the participant (81%). Of the 114 interactions, 98 alarms were resolved giving a success rate of 86% (or 99% including the decommissioning of equipment).



**Table 9: Overview of the outcome of the temperature missing data corrective plan**

Wave	Method	# households approached	Response rate (successfully contacted customer)	Success rate (issue successfully resolved, out of those contacted)
First	Letter	238	N/A	3%
	Door-knock	237	43%	30%
	Outbound call	119	45%	4%
	Passiv visit	107	93%	87%
Second	Letter	174	99%	6%
	Outbound call	165	80%	9%
	Door-knock	73	29%	5%
	Passiv visit	140	81%	86%

Table 10 shows the overall success rate in resolving equipment alarms across the two waves. The corrective action plan was successful in resolving a total of 249 equipment alarms across both waves (regardless the specific approach method adopted). This accounts for an average of 80% resolution rate for those who responded to intervention attempts.

**Table 10: Success rate in resolving equipment alarms**

Volume	Status	% of Responses	% of Approached
<b>Wave 1</b>			
238	Approached	-	100.00%
158	Responses	-	66.39%
127	Resolved	80.38%	53.36%
131	Resolved incl. Decommission	82.91%	55.04%
<b>Wave 2</b>			
173	Approached	-	100.00%
153	Responses	-	88.44%
122	Resolved	79.74%	70.52%
137	Resolved incl. Decommission	89.54%	79.19%

Although the corrective action plan proved successful in resolving problems, analysis has shown that around 20% of resolved alarms return within one week, 50% within one month and 65% within two months. The reasons for the reoccurrence of the alarms are complex, comprising a mix of participant behaviour and technical problems:

- The project believes that some participants have chosen to remove their sensors or to unplug their hub. This is likely to have been driven by a range of reasons; for example, one participant commented at a panel meeting that the temperature hub takes up a lot of space in his small kitchen where he's already very limited in terms of worktop space (though this participant did not indicate that he planned to remove his equipment).
- Some participants have reported sensors falling off the walls. Screwing in the sensors was an option offered to participants but most were not keen on anything that would damage the walls of their property. One panel member referred to his tenancy agreement which explicitly forbids any damage to the walls. Others have reported problems with the hub and flashing lights that indicate it is not working properly.

Partners are mindful of the fact that participants do not perceive that they will benefit from the temperature monitoring equipment in any way, unlike the other **energywise** equipment. Whilst the equipment is there for participants' protection, and this has been explained to participants when required, this aspect of the project has

not been actively promoted to participants to avoid the 'spying perception effect'. Several participants have expressed their frustration over the need for multiple corrective visits. Given the need to minimise dropouts to maximise the robustness of the research findings, it was agreed that, following the completion of the second wave, no further corrective action would be carried out unless a participant specifically requests it. Please note that the temperature monitoring protocols developed by the project still apply and the assessment of both conditional and trial effects is still carried out for all these active households transmitting valid temperature data.

### 8.4.3 Early observations and next steps

#### Condition effect – exception reports

PassivSystems produce a daily report on homes where the temperature has dropped below or risen above a certain point for three consecutive days, as per the thresholds listed below (Table 11). A project decision was made to amend the temperature exception report "TEMPDROP 1" from 18 degrees Celsius to 16 degrees Celsius. This ensures the project is immediately aware of significant threshold changes for all customers on a daily basis.

**Table 11: Temperature exception report criteria**

Criteria	Description
<b>TEMPDROP 1</b>	Sustained temperature drop below 16 degrees. List all homes where over the last three full days (i.e. midnight to midnight) maximum recorded temperature in both Zone A and Zone B is less than 16 degrees
<b>TEMPDROP 2</b>	Large temperature drop to 12 degrees. List all homes where over the last three full days (i.e. midnight to midnight) minimum recorded temperature in both Zone A and Zone B is less than 12 degrees

For winter 2015/16 (up to and including April 2016), exception reports were received for 24 households. A risk assessment was undertaken for these households, taking into account:

- The number of days and individual periods for which exception reports were received;
- The degree to which the minimum temperature threshold was breached;
- Data regarding the vulnerability of occupants (e.g. very young, very old, health issues or disabilities);
- Whether the household is on a prepay meter;
- Any vulnerability data held by project partners (including British Gas' and UK Power Networks' PSRs, housing provider data and plus CFO observations), e.g. age of occupants and health issues; and
- The likelihood the property was unoccupied at the time the temperature threshold was breached (based on the electricity consumption, with consumption below 1 kWh per day suggesting the property may be unoccupied).

The risk assessment categorised each householder as being at low, medium or high risk of suffering ill health due to the low temperatures observed. This found that:

- Seven households were considered to be high risk;
- Nine households were considered to be medium risk; and
- Eight households were considered to be low risk.

The following action was agreed in terms of these 24 households:

- No action for those at low risk;
- Those at medium risk to be monitored closely during Trial 2; and

- Those at high risk to receive a courtesy call from the CFOs and a subsequent intervention as appropriate.

The courtesy call with the seven high risk participants resulted in the risk assessment being downgraded to amber for six households, with the seventh identified as having moved house and therefore removed from the trial. The six households were considered to be fully in control of their home environment and not at risk – they reported being happy with their homes being cool. The reasons varied from personal comfort choice, to regularly staying at a family member's home.

For winter 2016/17 (up to and including March 2017), exception reports were received for 19 households. The risk assessment found that:

- Four households were considered to be high risk;
- Five households were considered to be medium risk; and
- Ten households were considered to be low risk.

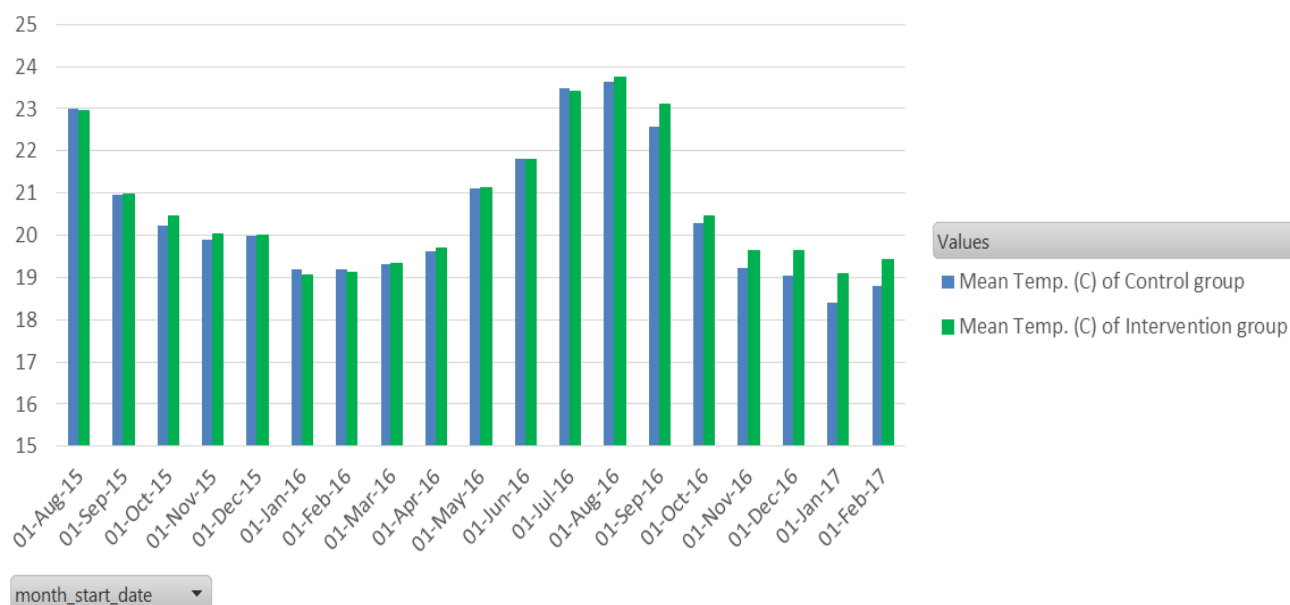
The courtesy call for the four high risk households, resulted in:

- Three customers being downgraded to medium or low risk. Again, all were considered to be in control of their home environment and not at risk. In one case, the temperature sensor was in an unused spare room where the heating was turned off.
- One customer was identified as requiring further intervention. This was arranged by the Bromley by Bow Centre through the Disclosure Board, where it was agreed the housing provider would work with the customer to resolve some outstanding home maintenance/improvement issues aimed at making the home warmer and comfortable. The housing provider will also assist this customer with downsizing to a smaller home that will be more appropriate to his needs as well as cheaper to heat.

#### **8.4.4 Trial effect – aggregated temperature analysis (intervention vs control group)**

The primary purpose of comparing the mean daily temperature of the intervention group compared to the control group is to determine if there is any trial effect on household temperatures. A trial effect in this scenario would be if the impact of being in the trial influenced the intervention group to experience lower indoor temperatures compared to the control group. An indicator of a trial effect would be average temperatures of the intervention group being lower than the control group or temperatures dropping more rapidly in the intervention group than the control group.

There has been no evidence of a trial effect in Trial 1. Average temperatures for control and intervention groups were found not have a statistically significant difference. Figure 54 shows that the intervention group experiences slightly higher mean temperatures (0.2°C averaged over all months) than the control group and the difference in temperature between the groups remains relatively constant through the period available for this report. Additionally, both groups appear to experience the seasonal impact of lower external temperature in a similar manner. Therefore, there is no evidence of a trial effect from this analysis. Note that the difference in temperature between the groups is not statistically significant.



**Figure 54: Comparison between the monthly mean temperatures observed in intervention group and those recorded in control group**

## 8.5 Compliance to Communication Plan and Data Privacy Strategy

The **energywise** Communications Plan and Data Privacy Strategy committed project partners to a suite of actions related to customer protection. To monitor compliance with these documents, actions have been listed in a spreadsheet and partners required to confirm implementation, providing evidence where appropriate. Ongoing implementation will be monitored through monthly updates to this spreadsheet.

The vast majority of actions relating to customer protection have been implemented as per the plan and strategy, with a small number of exceptions. These are listed below (Table 12), along with the alternative action taken and the rationale for this.

**Table 12: Vulnerable customer actions and alternative actions**

Action	Alternative action and rationale
Provision of Priority Services Register leaflet to all participants as part of the welcome pack.	It was found more appropriate to provide one point of contact for participants (i.e. direct line to Bromley by Bow Centre CFO team) to avoid confusion, while it was decided to advertise the PSR in targeted materials (such as the service charter for non-participants/leavers and the cold homes leaflet).
The team will keep a record of telephone conversations held with and enquiries raised by customers.	Recruitment inbound calls are recorded on the recruitment tracker. All other enquires have been recorded in hard copy and, from March 2016, electronically. Prior to this point, due to a period of sudden intense activity involving large numbers of CFOs and new customers, most enquiries were escalated immediately to the relevant partners.
At the point of sign-up and consent, each participant will be given or sent the project welcome pack and invited to attend a local drop in event.	Due to lack of attendance at first drop in event, further events were not held.



Action	Alternative action and rationale
Regular project newsletter sent to Group 1 during Trial 1 and to both Groups during Trial 2.	First project newsletter was sent end of June 2016, once all the installations were been completed and the first participant panel meetings held, designed to respond to queries raised at the panel meetings.
Once installation appointment made, this will be confirmed in writing with the participant by their preferred method.	Appointments have not been confirmed in writing. Many appointments have been booked the day before, making confirmation via writing not an option. Bromley by Bow Centre made the booking and passed this to British Gas for them to confirm the booking with customers.
All enquiries from participants will be shared between CFO team, UK Power Networks and British Gas with a tracker created for that purpose.	Customer enquiries have not been systematically shared with UK Power Networks. Enquiries have been directed to relevant partners (e.g. British Gas) via email or telephone. Enquiries tracker developed March 2016 due to key focus of Bromley by Bow Centre's CFO team on installation phase and on quick resolution of customer queries.
Participants asked to complete an exit survey.	Not always appropriate as some customers difficult to engage/talk to. They did not feel the need to explain reasons for not wanting to participate
Customers who are blind/partially sighted and those on electrical medical equipment will not take part in the trial.	<p>These customers could only be identified after they had signed up to take part (and therefore consented to their data being shared). On reflection, project partners are in agreement that:</p> <ul style="list-style-type: none"> <li>For those on electrically operated medical equipment, it would be better for these households to stay in the trial than to be disengaged, as there is no greater risk to them of losing electricity supply; indeed, they will be afforded better protection through being in the trial. It is therefore planned to keep them in the trial but ensure the CFO team and other partners are aware of the need to be very sensitive in their dealings with these customers, for example in terms of signing them up to the ToU tariff or asking them to complete surveys.</li> <li>For those identified as being blind/partially sighted, these customers can remain in the trial provided they are not the sole occupant in their household and also provided the customer field officers had also observed that the person signing up to the trial could read the project literature.</li> </ul>

Action	Alternative action and rationale
<p><b>Data Privacy Strategy</b></p> <p>Database B – University College London to appoint representatives that will have access to the personal identifiers, <b>maintain a log each time access to personal identifiers is required</b>, and obtained written approval from the Data Privacy Group in case the identity of the representatives needs to be changed.</p>	<p>Database B participant administration/management team have access to participant identifiers to maintain and update the University College London database as required and to deliver operational and research requirements (e.g. administration of surveys, updating dropouts) of the project. A log is not maintained as it is not pragmatically viable to do so given the constant and ongoing operational and administration tasks that require access to the personal identifiers in this database.</p>

## 9 Learning outcomes

The project to date has generated a wide range of learning outcomes. section provides a summary of the key lessons learnt gathered through the set-up phase of Trial 1 (both selection and recruitment of trial participants), the provision of energy saving interventions through the installation phase for Trial 1, the surveys administered to the trial participants, the 12-month data analysis of the electricity consumption and network impacts undertaken by the project, and finally though the customer protection activities undertaken to date.

The learning outcomes reported below are in addition to the lessons reported in SDRC 9.2.

### 9.1 Learning Outcomes: Selection of Participants

#	Lesson Learnt
L1.1	<p><b><u>Selection Criteria – Main Trial:</u></b></p> <p>In addition to the inclusion criteria for eligible households reported in SDRC 9.1 and 9.2 reports:</p> <ul style="list-style-type: none"> <li>A series of additional criteria were identified by project partners for exclusion of households from the project, for example leaseholders, those with energy efficiency improvements since October 2013 or planned over the course of the project and those in homes scheduled for demolition (11 criteria in total). The purpose of these criteria was to ensure a) that the data wouldn't be affected e.g. by energy efficiency improvements, b) householders were selected where there was smart metering solution available, c) the householder would remain eligible to take part in the trial and d) where possible, customers who may be adversely affected by participating in the trial (such as those reliant on electrically operated medical equipment) were not invited to take part.</li> <li>An additional series of 11 additional exclusion criteria were applied by British Gas, including households with a theft history, those that had requested not to receive marketing materials and those with a change of tenancy in progress.</li> </ul> <p>The result of this was that the pool of eligible households from which to recruit was smaller than expected – 1,352 rather than the target of 1,650.</p>
L1.2	<p><b><u>Selection Criteria – MDU:</u></b></p> <p>To ensure robust project learnings around innovative MDU solutions for tall and difficult buildings, the criteria for households in Padstow House were relaxed to include leaseholders, since only ten eligible customers were identified in this property, 6 of whom were leaseholders.</p>
L1.3	<p><b><u>External control group – Timing of Construction</u></b></p> <p>British Gas hold historic half-hourly data for all smart-meter customers and (once consent is given) this historic data can be used for external control group purposes. Thus, the external control group can be constructed after the initial recruitment period, as the external control group data can be collected for the desired time period.</p>
L1.4	<p><b><u>External Control Group – Required Sample Size:</u></b></p> <p>For the external control group (see Appendix A: External Control Group), a sample size of 680 in each region has been chosen. This sample size provides a 3.1% margin of error at the 90% level of confidence (exceeding the 5% margin of error requirement specified in the bid document). This larger sample size is necessary because of the need to allow for contamination effects; this sample size enables DNOs replicating the approach to be able to estimate their expected energy savings to within 100 kWh with 75% statistical power.</p>

## 9.2 Learning Outcomes: Customer Recruitment

#	Lesson Learnt
L2.1	<p><b><u>Method of Sign-up:</u></b></p> <p>The vast majority (79%) of participants signed up after receiving a door knocking visit with 81% of these signing up within three door knocks. This demonstrates the importance of having customer field officers interacting face to face with potential participants. Many said the invitation letter was an important precursor to this (though not enough, on its own, to persuade most to sign up; only 17 signed up after receipt of the letter).</p> <p>Other sign-ups came from telephone calls; of the 175 (94) participants signing up through this route 90% signed up after three or fewer calls. Only a handful of participants requested a booked home-visit, with only 3 sign-ups through this route, and no-one attended the drop-in event</p>
L2.2	<p><b><u>Interactions Before Sign-up:</u></b></p> <p>Two thirds of participants had two interactions with field officers before signing up and 90% of participants signing up after three or fewer interactions. 3% of participants required more than four interactions before they agreed to sign-up.</p>
L2.3	<p><b><u>Reasons for Sign up:</u></b></p> <p>For most participants, the main reason for taking part in the project was the chance to reduce their energy costs. For some, the main reason was better visibility of their energy use or the offer of free devices. Secondary reasons included the devices and taking part in an interesting project. Some customers also signed up to the project in order to receive a smart meter installation from British Gas.</p> <p>Participants' comments about the field officer team were generally very favourable, commenting on their friendly and professional approach and the role the field officers played in persuading participants to take part in the project.</p>
L2.4	<p><b><u>Reasons for not Signing-up:</u></b></p> <p>43% of those invited to take part were not interested in taking part in the project. The primary reason given was lack of interest in the project (with primary sub-reasons being too much hassle, being sceptical of change or too busy), followed by ineligibility (13%), for example because they were changing supplier or moving house. 5% stated they were not interested in having smart meter, and 4% said that they did not want to take part because their bills were already low.</p>
L2.5	<p><b><u>Scope for Improving the Recruitment Approach:</u></b></p> <p>Some customers had initially thought the letter was about switching energy provider and had discarded it on that basis. Suggestions for improving the efficiency and cost effectiveness of the recruitment included:</p> <ul style="list-style-type: none"> <li>• Additional messaging with pictures and information what will be installed and by whom;</li> <li>• For door knocking, pair a field officer from Bromley by Bow Centre with someone from either British Gas or the housing provider to maximise take-up – and ideally also have a male/female pairing;</li> <li>• Have a smaller team of recruiters with a higher level of training, including refresher training, and quality assurance of the door knocking to ensure accurate messages are communicated;</li> <li>• Electronic capture of data at the doorstep; and</li> <li>• Use of uniforms to increased recognition and trust (in addition to product badges).</li> </ul>



### 9.3 Learning Outcomes: Customer Protection

#	Lesson Learnt
L3.1	<p><b><u>Temperature Monitoring Protocol:</u></b></p> <p>It has proved challenging to develop a protocol for taking action related to evidence of dangerously low temperatures in individual homes. Partners were in agreement that to accurately assess the risk to a household, a household visit would be necessary, but this was deemed too intrusive. A risk assessment system has been devised that uses all the information held by project partners, which is felt to offer the best approach, though is recognised as having limitations.</p>
L3.2	<p><b><u>Vulnerability:</u></b></p> <p>The project had committed to monitoring participants' vulnerability and to ensuring that those deemed 'too vulnerable' were excluded from the trial; specifically, it was anticipated that this would include:</p> <ul style="list-style-type: none"> <li>• Customers who are blind or visually impaired (since there is currently no IHD suitable for these customers);</li> <li>• Customers dependent on electrically operated medical equipment.</li> </ul> <p>These criteria were re-considered as part of the vulnerability review carried out in May 2016 and it was decided that customers in the above categories should, in the majority, be retained in the trial:</p> <ul style="list-style-type: none"> <li>• For customers who are blind or visually impaired, they should be retained as long as there are others in the households and as long as the field officer has observed that at least one householder can read the project literature.</li> <li>• After the smart meter is installed, it was agreed that customers with electrically operated medical equipment are at no greater risk of a power outage than they would be outside of the trial and, in fact, are afforded greater protection in the trial due to the field officer team and dedicated Freephone number. It was therefore agreed that they should be retained, but that field officers should be sensitive to their situation when asking, e.g. for participants to complete surveys.</li> </ul>
L3.3	<p><b><u>Customer Panel:</u></b></p> <p>It proved harder than anticipated to recruit participants to become members of the customer panels. An invitation to all participants in the welcome pack to apply to join the panel elicited no responses, and a considerable amount of field officer time was required to recruit customers to the two panels (intervention and control groups). This was despite a £30 voucher being offered to those attending. Several participants who had said they would attend did not show up on the day, resulting in six participants at each panel (versus a target of 10-12). However, despite these challenges, the inaugural panels proved to be a very useful forum in gathering participant feedback.</p>
L3.4	<p><b><u>Role of local intermediaries in customer protection:</u></b></p> <p>The customer protection measures described in Chapter 8 demonstrate the project's commitment to customer protection and the key role played by the local partners in customer support. Given the relationship established between many trial participants and the customer field officer team, they are best placed to investigate the customer circumstances and assess the level of risk the households might be exposed to. Through the partnership with the local intermediaries, the project can run unobtrusive risk assessments and intervene with high risk households when needed by liaising with the relevant social housing association that can provide the appropriate support services.</p>

## 9.4 Learning Outcomes: Drop-outs and Ongoing Engagement

#	Lesson Learnt
L4.1	<p><b><u>Project Drop-Outs:</u></b></p> <p>In contrast to the high response rate achieved the project has suffered substantial dropouts during the installation phase. This is in part due to the requirement for installation of temperature monitors in living rooms and bedrooms; part due to the disruption to participants caused by the difficulty in scheduling simultaneous installations of the smart meters and temperature loggers; and in part due to the success of the recruiting process in that it was able to persuade some households to participate who were only marginally interested in trial, and who took the opportunity to withdraw when other circumstances (such as issues around installation) presented the opportunity.</p> <p>The single main reason for project disengagement was that participants changed supplier. A range of problems associated with accessing homes and problems with meters contributed to the majority of disengagements. The two main drivers for customers choosing to withdraw were not wanting a smart meter and the general hassle of the installation process (linked to the disruption to participants caused by the difficulty in scheduling simultaneous installations of the smart meters and temperature loggers). A third significant factor was that customers changed their minds about the project after signing up. This may be down to success of the recruiting process in that it was able to persuade some households to participate who were only marginally interested in trial, and who took the opportunity to withdraw when other circumstances (such as issues around installation) presented the opportunity. Project partners have identified three key actions that they believe would have reduced the numbers of households dropping out:</p> <ul style="list-style-type: none"> <li>• Clearer messaging of what is involved in the project, possibly including a video;</li> <li>• Avoidance of the need to install temperature monitoring equipment; this can present technical issues requiring multiple visits, and which are also more intrusive as they require an installer entering a customer's bedroom (not just the hallway/kitchen, which is all that's required for the smart meter install)</li> <li>• Streamline the process to reduce the number of interactions with customers</li> </ul>
L4.2	<p><b><u>Participant Interviews as Point of Escalation for Project Issues:</u></b></p> <p>Participant interviews, designed to evaluate the effectiveness of the recruitment approach, have proved useful in flagging up a number of issues. Some interviews demonstrated that not all problems are reported to the <b>energywise</b> field officer team. For example, a few participants flagged up they were experiencing some problems with topping up prepay gas smart meters.</p>

#	Lesson Learnt
L4.3	<p><b><u>Ongoing Engagement:</u></b></p> <p>Partners have identified a number of key learnings to maximise ongoing engagement with participants:</p> <ul style="list-style-type: none"> <li>• Keep in regular communication with participants to remind them of how useful their involvement is and to thank them for their time – with vouchers where deemed appropriate (e.g. where many customers have faced disruption due to problems with temperature monitors);</li> <li>• Use learning from early stages of the project to improve the process later in the project; e.g. on <b>energywise</b>, Trial 1 learning in terms of equipment installs for the intervention group can be used to improve the experience of control group customers in Trial 2;</li> <li>• Minimise customer interactions and 'hassle' to minimise dropout rates, e.g. by getting different parties to work together to attend a household at the same time where possible; and</li> <li>• Don't wait too long to give the control group their devices. Participant panels held in late summer 2016 identified that control group participants were frustrated at having to wait so long between signing up to the project and receiving their energy efficiency devices. Therefore, the delivery of these devices was brought forward from the start of Trial 2 to December 2016. <ul style="list-style-type: none"> <li>○ As of 19 April 2017, 13 of the 134 active control group participants are yet to receive their devices. 12 of these are due to get their deliveries in early May, whilst the other has failed to be home at agree times. He has agreed to come into the Bromley by Bow Centre to collect his devices if he wants them.</li> </ul> </li> </ul>

## 9.5 Learning Outcomes: Installation Process

#	Lesson Learnt
L5.1	<p><b><u>Installation Visits:</u></b></p> <p>While it was envisaged that participants would have received one single visit combining both British Gas' and PassivSystems' installations with field officer's visit (aimed at administering the home energy survey to all participants and delivering the energy efficiency devices and advice leaflet to intervention group), this proved impracticable due to the levels of resource required plus the different amounts of time required by different partners at the property. In addition, the smart meter installations required power to be disconnected which was not compatible with the temperature monitoring equipment installation that required the power to be on.</p>
L5.2	<p><b><u>Installation Approach – Customer Feedback:</u></b></p> <p>Of 30 participants interviewed, 27 were happy with the installation process though three were not. Four of 15 intervention group participants reported some kind of technical problems with their smart energy display, four expressed experiencing some form of delay with smart meter vends, and five reported problems with temperature sensors falling off. Again, some interviews demonstrated that not all problems are reported to the <b>energywise</b> field officer team or to the energy supplier. Engagement activities might be useful to identify technical problems. The project partners worked collaboratively to resolve any customer queries and confirm understanding of the smart meter vend processes.</p>
L5.3	<p><b><u>Scope for Improving Installation Process:</u></b></p> <p>Partners have identified the following options for improving the installation process in any replication:</p> <ul style="list-style-type: none"> <li>• Avoid temperature logging equipment if possible as it has generated many problems. If this equipment is necessary, consider having the same organisation installing this as well as the smart meter, or at least brand the other organisation the same, and aim to minimise customer interactions;</li> <li>• Link up all those involved with install/delivery so that they can attend a customer's house at the same time where possible, to minimise hassle (though it is recognised that this is challenging given the different time and other requirements of the different groups);</li> <li>• Train up field officers to install and demonstrate equipment where possible (e.g. the kettle and the standby shutdown), and provide a dedicated equipment manager with a van to deliver the equipment;</li> <li>• Pilot the installation process with a few households and then tweak the process as necessary</li> </ul>



## 9.6 Learning Outcomes: MDU Installations

#	Lesson Learnt
L6.1	<p><b><u>MDU Full Shared Infrastructure:</u></b></p> <p>A key learning through the project was that the MDU Communication Backbone supplied by Siemens will not offer 100% home area network coverage to the entire building/all residents as previously expected. As “channel masking” (see 2 below) is not used each flat requires an individual set of Zigbee radio equipment to ensure all Zigbee radio traffic is collected and extended through the MDU network. The equipment costs required for full building coverage depend on the number of flats within the building. Padstow House has 68 flats meaning the equipment costs are too high and would greatly exceed the project budget. Instead the MDU installation will resemble more of a point to point shared infrastructure solution. This is where equipment for only the recruited customers will be installed into the building, meaning only they will receive the extend HAN services (rather than all tenants). For example, for our 3 customers, Siemens only install equipment that will collect and transmit data for 3 meters within the meter room. If customers reside on building floors 2 and 5, then the transmission equipment is only installed onto floors 2 and 5.</p>
L6.2	<p><b><u>MDU installation process:</u></b></p> <p>Siemens require a white list of all assets to be installed into the building pre installation in order to load these into their building control centre and enable Siemens to route the Zigbee radio traffic (containing smart meter data) accordingly to each customer.</p>
L6.3	<p><b><u>MDU installation process:</u></b></p> <p>The project learnt that Siemens are required to be on site for each smart meter installation due to the channel agility installation process British Gas uses when installing smart meters. Siemens are required to “sniff” or detect the Zigbee radio channel the meters are operating on and then commission their systems using the same channels for each customer. Upon commissioning the British Gas smart meter communications HUB automatically searches and acquires the channel with the least “noise” to ensure the most reliable and sustainable home area network (HAN). The Siemens solution requires Zigbee channels to be fixed (“channel masking”) in order to perform the commissioning remotely. As this is not the case with British Gas installation and commissioning process, Siemens are required to attend.</p>
L6.4	<p><b><u>MDU Installation Process:</u></b></p> <p>It was found that the installation process for tall and difficult building solution requires less time for engineers to be inside customer properties which greatly benefits the customers. This is because the smart metering home area network can be created outside of the customer’s home (landings or hallways), meaning the meters and in home display are paired and communicating with each other before the engineer enters the property. The engineer only has to perform customer service processes inside the customer’s home, not any technical work.</p>

#	Lesson Learnt
L6.5	<p><b><u>MDU Installs - Landlord Engagement:</u></b></p> <p>The project has already made some valuable commercial learning regarding landlord engagement and authority to install in these tall and difficult buildings. Tower Hamlets Homes preference was to draw up a separate “license agreement” (maintenance contract) with the tall and difficult building solution supplier pre installation in addition to the original collaboration agreement signed by all project partners.</p> <p>More engagement and understanding amongst social landlords is required for the larger smart roll out as landlords have to be mindful about tenant benefits as well as about the commercial agreements. Due to the nature of these contracts direct communication and agreements between the landlord and the solution supplier would be best suited.</p>

## 9.7 Learning Outcomes: Equipment

#	Lesson Learnt
L7.1	<p><b><u>Control group – Secondary Electricity Meter Installation:</u></b></p> <p>It was originally planned that control group participants would have a secondary electricity meter installed for the purpose of data collection in Trial 1. However, it was found that for in most cases, there was insufficient space for this. Instead:</p> <ul style="list-style-type: none"> <li>• Credit customers in the control group have had a credit smart meter(s) installed but the smart energy display will not be provided until Trial 2;</li> <li>• Prepayment customers in the control group have had a (space efficient) Navetas electric loop installed (this is because certain prepayment functionalities are not accessible if a prepayment smart meter is installed without the smart energy display).</li> </ul>
L7.2	<p><b><u>Smart Meter Installations:</u></b></p> <p>When attempting to install smart meters into flats British Gas have learnt there are additional difficulties when compared to installing into houses. Some properties have locked meter rooms which require caretaker access. Locked meter rooms resulted in several aborted installations that required rebooking, in many cases two additional visits were required as often the caretakers did not attend and allow access to the meter rooms for the second installation visit, resulting in a third. For the meter rooms where caretaker access was not required most meters were readily accessible. However, some did require a Gerder key. These are instances where the meters are locked behind a cage or metal obstruction (Gerder). This again requires either council or landlord access in order to unlock the obstruction and exchange the meters.</p>
L7.3	<p><b><u>Temperature Monitoring Equipment:</u></b></p> <p><u>Reasons for temperature data loss:</u></p> <p>During the PassivSystems corrective action plan two major reasons for data loss from the temperature monitoring equipment were observed: 1) the temperature sensors falling off the wall, and 2) the communication hub used to transfer the data going offline.</p>
L7.3a	<p><b><u>1. Temperature sensors off the wall:</u></b></p> <p>The project has investigated the reason why some temperature sensors were off the walls. In some cases, it was found that they were removed by trial participants from the wall (e.g. they didn't like having one in the bedroom), while in other cases they had fallen off the walls. In the latter case, a new fixing method was employed in July 2015 and, through supervision, the quality of installs has been improved.</p>
L7.3b	<p><b><u>2. PassivSystems' communication hub offline:</u></b></p> <p>The PassivSystems temperature monitoring equipment uses a communication hub to collect and transfer data, via the internet. This hub has to remain powered on and connected to the internet at all times in order to do so. Through the PassivSystems corrective action plan it was found that a lot of customers were unplugging either the broadband or the power source from the hub rendering it unable to transfer data. In other occasions, customers were removing the temperature sensor installed in the bedroom as it was deemed too intrusive. Although this is an easily resolved issue it is inherent in customer behaviour. It is important that customers fully understand the purpose of each individual piece of equipment provided and what the operational requirements are to function correctly. If possible, other less intrusive and resource intensive options for ensuring customer protection should be considered.</p>

#	Lesson Learnt
L7.4	<p><b><u>Half-hourly Data:</u></b></p> <p>British Gas identified an error within the technical configuration of the head end system affecting half-hourly meter readings for 48% of the project's smart meter credit installations. This lay within a technical meter message and did not affect the customer experience, any of the customer journeys, or customer billing in any way. Upon installation, the half-hourly read schedule did not successfully update on some meters. This meant that the half-hourly readings for these meters was not returned to British Gas' read repository and could not be extracted for project analysis.</p> <p>British Gas discovered the issue in January 2016 and rectified it in February 2016. Therefore, the affected customers' half-hourly readings are missing from May 2015 to February 2016 (dependant on the smart meter installation date, as installations continued until November 2015). All credit customers are now set to half-hourly meter reading schedules and the data is successfully being returned to the read repository.</p> <p>A similar error existed within all 65 smart prepayment meters installed in the project, which equates to 52% of the project's total prepayment meter population. Here the meters were not returning the half-hourly reading schedule but had successfully received the configuration to do so. The meters were returning daily readings. Again, this error lied within a technical meter message and had not affected the customer experience, any of the customer journeys, or account balances in anyway.</p> <p>Following an investigation with British Gas' meter manufacturer and the head end service provider, a root cause was established and a solution was successfully developed. This solution was implemented and now allows transfer of half-hourly consumption data along with the daily consumption data. British Gas also investigated a technical solution to recover the historical data stored within the meters; unfortunately, the error resulted in incorrect data being recorded and as such the historical data cannot be recovered. Therefore, the project's smart prepayment meter customers' half-hourly readings are missing to date for Trial 1.</p> <p>At the planning stage a project should build in additional contingency in the project timeline to make sure that unexpected issues that involve third parties can be addressed without having an impact on key project milestones. Contingency in the project budget is also fundamental to resolve key issues. For data-based trials, regular checks have to be embedded in the project plan to make sure all data is coming through correctly or to identify any potential issue at early stage.</p>
L7.5	<p><b><u>Qualitative Feedback on Equipment from Participant Interviews:</u></b></p> <p>Interviews with a sample of the intervention group (15 participants) found that usage of the devices provided varied:</p> <ul style="list-style-type: none"> <li>• The smart energy display was the most widely used device with 13 out of 15 using this regularly, to monitor energy use and, where relevant, credit. Seven said they had changed their behaviour as a result. However, seven reported technical problems with their display;</li> <li>• 11 of the 15 were using their LEDs lightbulbs. Usage would have been increased if the field officers had been able to fit the bulbs for customers (though partners felt that safety issues may make this impossible);</li> <li>• The kettle being used by 8 out of 15. Reasons cited for not using it included that it was too heavy, not needed, had insufficient capacity, had stopped working or was difficult to use. Demonstrations of the equipment by the field officers would have slightly increased usage;</li> <li>• The standby shutdown is being used by 7 out of 15 interviewees; others suggested they didn't need it or weren't sure how it worked. Usage of this device would have been increased if field officers could have set up the equipment for some participants;</li> <li>• Six of the 15 said they had read the advice leaflet, only one of whom said they had implemented any of the advice.</li> </ul>



## 9.8 Learning Outcomes: Research Aspect

#	Lesson Learnt
L8.1	<p><b><u>Research Trials Targeting Fuel Poor Customers:</u></b></p> <p>The primary observation from the recruiting phase of the trial is that fuel poor customers seem as willing to participate in research projects as non-fuel poor customers. A direct comparison however is difficult because, to the project's knowledge, no other UK trial has so clearly defined its research population, participant selection criteria, and sample frame, and recorded non-response rates accurately enough to define the response rate of the trial in a comparable manner to <b>energywise</b>.</p>
L8.2	<p><b><u>Response Rates:</u></b></p> <p>All of the trials of smart metering and related DSR technologies of which the project is aware have recruited on an opt-in basis with an unbounded sample frame achieving low participation rates. The <b>energywise</b> project achieved a 40% response rate which far exceeded all industry and academic expectations. This shows that the application of best practice social research and project management methods for the recruitment of participants can achieve higher response rates in energy trials from any subsection of the population.</p>
L8.3	<p><b><u>Drop Out Rates:</u></b></p> <p>Drop outs were higher than anticipated – see L4.1</p>
L8.4	<p><b><u>Trial 1 Start Dates:</u></b></p> <p>Originally the project partners envisaged to use the installation date as individual Trial 1 start date for each participant. However, given the differences between British Gas and PassivSystems installation dates and the delivery dates of the energy efficiency devices &amp; energy efficiency advice leaflet, it was agreed that it was more appropriate to use the date of the first smart meter readings coming through as the start date for each individual household. This is because, from the participant's perspective, the receipt of the smart energy display and the interaction with the British Gas Smart Energy Expert constitutes what is likely to be the single largest intervention in energy savings terms. Local levels of trust are higher for households who have Bengali as their primary language.</p>
L8.5	<p><b><u>Research Insights:</u></b></p> <p>A statistically significant result of 3.3% energy saving for the (intervention group compared to the control group) is an important insight obtained from Trial 1. This is in line with reported energy savings from the installation of smart meters for other trials targeting different demographic sectors. This suggests that the fuel poor may respond to energy savings in a similar way to other sociodemographic sectors of society.</p> <p>The appropriateness of the 'difference in difference' method for comparison of pre and post trial data where there has been a change in measurement instrument (from conventional to smart meters) for Trial 1 analyses is a useful learning from a research perspective. Although this approach has been widely used, its robustness to variation in measurement instrument in randomised control trials is not widely noted.</p>

#	Lesson Learnt
L8.6	<p><b><u>Contamination effects:</u></b></p> <p>Contamination effects are a significant threat to the conduct of randomised control trials. <b>energywise</b> has undertaken significant testing to ensure that these have not effected the results. This has been done through careful tracking of reasons for withdrawn from the trial, allowing for case by case analysis and comparison of these between intervention and control groups to check for any systemic bias in withdrawal reasons.</p> <p>Additionally, through construction of external control groups across different DNO climate regions and statistical comparison with within trial groups has allowed for statistical analysis of any potential contamination effects. This shows that careful documentation and multiple sources of evidence provide valuable cross-checks in many aspects of ensuring robust trial design.</p> <p>These sources of evidence have provided strong evidence of no control group contamination effects within the <b>energywise</b> trial.</p>
L8.7	<p><b><u>Statistical generalisation:</u></b></p> <p>Generalisation involves drawing conclusions about the extent to which the finding within the trial are likely to hold in wider populations and settings. This is also known as the external validity of the trial findings. Through construction of an external control group of participants recruited on the same criteria as those in Tower Hamlets in each of five different climate regions across Great Britain, <b>energywise</b> has been able to show that the annual consumption profile shapes of these areas are not statistically significantly different from those in intervention group in the Tower Hamlets area. This, in conjunction with the lack of control group contamination effects supports the conclusion that the percentage savings found in the Tower Hamlets area are likely to hold in other DNO regions across Great Britain.</p>
L8.8	<p><b><u>Survey Administration:</u></b></p> <p>The approach of field officers assisting customers with the completion of the Home Energy Surveys during installation visits resulted in a good response rate to the Home Energy Survey, of 95%. 5% were left with participants for self-completion and they were all returned but one.</p>
L8.9	<p><b><u>Energy Social Capital Survey Insights:</u></b></p> <p>The findings from the surveys indicate some level of information seeking about energy and a fair amount of 'energy social capital':</p> <ul style="list-style-type: none"> <li>• 146 out of the 179 respondents knew people in their social networks to whom they would turn for energy related advice;</li> <li>• 80 respondents (45%) had had a conversation in the last 6 months related to electricity;</li> <li>• Trust varied through the sampled population, with a majority trusting people in the local area, while only 21% trusting people 'in general'.</li> </ul> <p>The findings suggest that electricity usage and energy related issues are not a specific or overwhelming concern for this group, but most have social resources they can turn to if there is an issue they'd like to discuss and many use the media or other organisations as sources of information and advice.</p>

#	Lesson Learnt
L8.10	<p><b><u>Qualitative Customer Insights:</u></b></p> <p>Learnings to-date include:</p> <ul style="list-style-type: none"> <li>• Some participants don't use their central heating, for various reasons; including perceived cost and perceived health impacts. Some use additional heating at certain times, e.g. when they want to get warm instantly when getting home from work;</li> <li>• Several participants reported problems with their central heating and most of them use alternative electric heating to compensate for this;</li> <li>• Appliances move around with extended family members – e.g. visiting grandchildren bring electronic games consoles with them. Similarly, visiting family members may help with e.g. washing, which impacts on the timing of appliance use;</li> <li>• Generally, feedback on the surveys showed that the vast majority found them easy to fill in, with only 1 (out of 52) finding it time consuming and three raising concerns about confidentiality or sensitivity of data;</li> <li>• Two people mentioned that having a Bengali speaking field officer was a help.</li> </ul>
L8.11	<p><b><u>Network Insights:</u></b></p> <p>The main outcome of the analysis of the network data is that the load profiles of the trial participants align well with the load profiles of the secondary substations to which they are connected. This has potentially beneficial implications for any realised energy savings or peak demand shifting by the trial participants, since these load reductions and/or shifts are more likely to align with the reinforcement deferral requirements of the secondary substations.</p> <p>The Trial 1 results also indicate that the <b>energywise</b> interventions were associated with an average reduction in evening peak demand (taken to be between 17:00 to 22:30) of 23 W per household. This represents about a 5.2% reduction in average evening peak demand per household, and reflects the capacity for meaningful engagement with energy savings by the trial participants.</p>

## 10 Conclusion

This report is focused on the results from Trial 1 and on the valuable customer insights collected through the research surveys, 30 interviews with trial participants and several interactions between the customers and the CFO team. This last chapter summarises the key lessons generated from the project through:

- The set-up phase of Trial 1 (including the selection and recruitment of trial participants);
- The provision of energy saving interventions through the installation phase for Trial 1);
- The surveys administered to the trial participants; and
- The operational phase of the energy saving trial (including the data analysis and the customer protection measures in place).

Including the MDU recruitment undertaken in 2016, the project approached 1,352 households in Tower Hamlets with a total of 538 sign-ups, which represented a response rate of 40% and exceeded the 33% target. The project subsequently experienced 244 drop-outs, resulting in 294 active participants as of 28 April 2017. Out of the recruited 538 households, 42% of the properties are in EPC rating band C, 42% in band D and 17% in band E to G. This may be an indication of improvement works carried out by the social housing providers before October 2013 (the threshold set up by the project for the exclusion criteria of trial participants).

Other interesting findings around the households involved in the project, their demographic and their attitude towards sources of information around energy have been gathered through the Home Energy survey and the Energy Social Capital survey developed by University College London. Looking at the 278 completed Home Energy surveys analysed for this report, it is evident that the majority of trial participants are Bangladeshi (154 households out of 278) or White British (58 out of 278), which is reflected by the primary language spoken at home (114 households speaking Bengali, 119 English, and 25 English and Bengali). Also, the **energywise** participants appear to have significantly larger households compared to the general population (3.53 members in average versus 2.38) with intervention group showing a higher occupancy level than the control group. While the household's income is generally quite low, several households reported that they receive housing benefits and child benefits, followed by some receiving income support and/or other state benefits. Finally, 76 households out of 278 have at least one child under five years old while 57 households have elderly residents (aged over 65).

The responses received to the Energy Social Capital survey indicate some level of information seeking about energy and a fair amount of energy social capital with the majority of energy social capital resources lying within the family. The findings suggest that electricity usage and energy related issues are not a specific or overwhelming concern for this group, but most have social resources they can turn to if there is an issue they'd like to discuss and many use the media or other organisations as sources of information and advice.

Interactions between customers and CFOs were also identified as another channel to gather information around attitudes towards energy. For example, it was captured that some participants don't use their central heating, while several reported problems with their central heating (with most of these using alternative electric heating to compensate). It was also found that extended family members move between households, which may alter not only the pattern of electricity consumption, but also the appliances in the home.

All active participants have received their monitoring equipment and Trial 1 interventions (where relevant) depending on their group allocation. Through the completion of Trial 1 installations and the provision of other energy efficiency measures such as energy efficiency devices and advice, the project has gathered valuable learning on how to deliver energy saving interventions to this customer base and particularly how to address some of the challenges faced by the smart metering roll-out when extended to flats and tall buildings with difficult meter arrangements. As many fuel poor customers live in flat or tower blocks, overcoming these challenges is key to enable them accessing the benefits of smart metering solutions. Within this context, the project has successfully demonstrated the UK's first end to end installation of residential smart meter sets operating across a multiple dwelling unit/tall and difficult building solution.

An assessment of potential customer benefits of Trial 1 interventions in fuel poor households was conducted by analyses of Trial 1 data. Electricity consumption in the intervention group was compared to consumption in the control group (who did not receive the intervention measures). The analyses of Trial 1 electricity saving used a



'difference in difference' approach with results showing a 3.3% reduction in electricity consumption in the intervention group when compared to the control group, when both credit and prepayment data are taken into consideration. This result is statistically significant at the level set out in the project bid (0.75 statistical power level for differentiating between the intervention and control group).

This is an important insight which helps quantify the energy saving potential of fuel poor customers in response to smart meters (smart energy displays) and further develops the overall evidence base relating to consumer engagement with smart meters. The fuel poor demographic seems to save similar amounts of energy to other demographic segments in society when presented with a smart meter<sup>32</sup>.

This report includes an assessment of the implications for network loading that can be drawn from the 12 months of half-hourly smart meter data from Trial 1. Through the analysis of the half-hourly monitoring data of all available credit meter customers, learnings have been generated in relation to the electricity usage characteristics of fuel poor customers (as represented by the participants in this trial) and how the participant load profiles relate to those of the network assets to which they are connected. From the analysis of Chapter 6, it can be seen that the average consumption of the **energywise** trial participants is considerably lower than that observed in other projects, such as the LCL and CLNR trials, over the same calendar months. This is in line with the findings of the LCL trial analysis of the impacts of household income on average diurnal consumption profile and reflects the demographic composition of the participants in the **energywise** study, which is targeted at fuel poor customers.

Results show that there is a strong correlation between the **energywise** participant profiles with the mean secondary substation load profiles indicating that energy saving and peak shifting responses from the trial participants have the potential to directly benefit the secondary substations to which they are connected. Less correlation has been observed in the case of primary substations, which reflects the more diversified nature of the primary substation loads and the higher proportion of industrial and commercial loads (which typically increase loading during the daytime) at this level

The Trial 1 results also indicate that the **energywise** interventions were associated with an average reduction in evening peak demand (taken to be between 17:00 to 22:30) of 23 W per household. This represents about a 5.2% reduction in average evening peak demand per household, and reflects the capacity for meaningful engagement with energy savings by the trial participants. When assessing the network impacts that could be achieved if the **energywise** Trial 1 energy savings were realised by all households classified as fuel poor within the UK Power Networks licence areas, an estimated total annual reduction in electricity consumption of 56 GWh could be achieved across the three licence areas. This corresponds to an average reduction in the evening network load of approximately 14 MW.

The load forecasting scenario tool used by UK Power Networks to model future loads across its three licence areas, the EELG model, was modified for the purpose of the project in order to address fuel poor household archetypes in the domestic sector. This will allow the integration of scenarios on how fuel poor customers respond to energy saving and demand shifting interventions into UK Power Networks' network planning processes.

Finally, the project also looked at different customer protection measures put in place to ensure no harm is caused to participants because of the trials. Among these, it was proved challenging to develop a temperature monitoring protocol for taking action related to evidence of dangerously low temperatures in individual homes. Partners were in agreement that to accurately assess the risk to a household, a household visit would be necessary, but this was deemed too intrusive. A risk assessment system has been devised that uses all the information held by project partners, which is felt to offer the best approach, though is recognised as having limitations. No statistically significant evidence of a trial effect on the temperature in the household was identified through the data analysis carried out by University College London over the winter months, with both groups experiencing the seasonal impact of lower external temperature in a similar manner.

The activities described in Chapter 8 demonstrate the project's commitment to customer protection and the key role played by the local partners in customer support. Given the relationship established between many trial

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<sup>32</sup> DECC (2015) 'Smart Metering Early Learning Project: Domestic Energy Consumption Analysis - Report and Technical Annex'. The energy savings reported by DECC apply for standard SMETS1 electricity smart meter. The study does not include the additional energy saving interventions provided by the **energywise** project.

participants and the customer field officer team, they are best placed to investigate the circumstances and assess the level of risk the households might be exposed to. Through the partnership with the local intermediaries, the project can run unobtrusive risk assessments and intervene only when needed by liaising with the social housing association that can provide the appropriate support services.

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## Appendix A: External Control Group

The process for selection and recruitment of the external control group was refined and simplified to maximise the similarity with the participants in the Tower Hamlets study area.

The process contained three key steps and can be summarised as follows:

- Firstly, British Gas applied their fuel-poverty indicator constructed from data held across different British Gas business systems. This creates a subset of 'fuel poor' customers.
- Secondly, the eligibility screening criteria used to select customers in the Tower Hamlets study area were applied. These screening criteria included: gas central heating smart meter customers for which there is data back to 1 January 2016. This eliminated customers on electricity heating tariffs such as economy 7 or 10, and those on district heating schemes. This creates a subset of **energywise** fuel poor customers.
- Finally, all remaining eligible customers were approached to participate on an opt-out basis.

These customers were grouped into "DNO climate regions" of which six were identified within Great Britain. These climate regions were determined by climate factors and minimise variation within each region by the key determinants driving variations in electricity use including variation in daylight hours, heating degree days and cooling degree days. Of the six climate regions, one Northern Scotland, had significantly too few eligible customers (99) to allow for construction of an estimate of the energy savings likely to arise in that region using the same methodology is used for other climate regions. Consideration was given to grouping the climate regions of Southern Scotland and Northern Scotland together, however due to the significant climatological differences (particularly differences in daylight hours) made this unjustifiable. For this reason, the estimates of the savings arising in northern Scotland Northern Scotland, has been initially based on that of Southern Scotland, and further analysis will be undertaken through construction of regression models to refine this estimate for Scottish Hydro Electric Power Distribution. This is a project constraint arising from the geographical distribution of the project partner's (British Gas) customer base.

To estimate required numbers, prior calculation of the final required numbers per DNO climate region was undertaken. This arrived at a figure of 680 per climate region. Once allowing for recruitment refusals, dropouts, supplier changes and tariff changes this figure was inflated to 960 per climate region. This figure was determined by the need to estimate any potential contamination effects arising within the trial, and to be able to tell DNOs replicating the approach that the method can say with the project's agreed levels of statistical power and confidence their expected energy savings to within 100 kWh. This figure exceeds the requirement in the bid document of calculating external validity using 5% margin of error and a 90% level of confidence (a final sample size of 680 provides a 3.1% margin of error at the 90% level of confidence).

External control group participants were recruited during April and May 2017, however their smart meter data is available back to the start of 2016 to allow for analytical comparison with participants in Tower Hamlets.

In Section 5.3 it was shown that there were no observable contamination effects between the intervention and control group thus supporting the generalisation of the finding to the different DNO climate regions and hence to the different DNO areas in Great Britain.

An additional form of analysis for contamination effects was carried out with the data from the external control group. An analysis of variance (ANOVA) test was conducted across the five climate regions into which the external control group data was aggregated, with the intervention group in Tower Hamlets. It is important to note here that the external control group data is primarily required for Trial 2 and hence contains British Gas customers with dual fuel or electricity smart meters – they are therefore expected to behave in a manner similar to those in the intervention group in Tower Hamlets (not the control group for Trial 1).

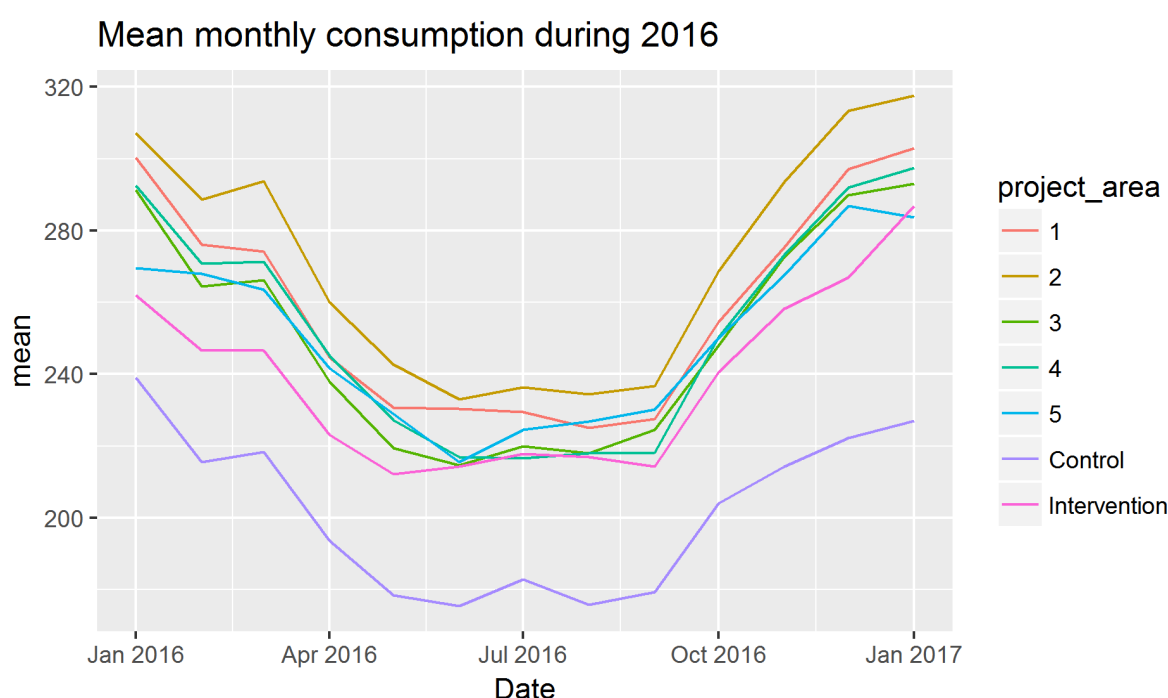
Similar to the rest of the study outliers in the external control group climate regions were defined using the Tukey method on the percentage change in consumption, and all values outside 1.5 times the Interquartile range were removed. Outlier detection resulted in 315 observations being removed approximately 8% of the total. The analysis of variance test of the data across all regions' smart metered participants showed that there was no significant difference in the change in the means of the groups' consumption between January 2016 and January



2017. This shows that the intervention group in Tower Hamlets behaved in a statistically similar manner to smart meter customers in each of the other climate regions across Great Britain, while the difference in difference analysis shows that the intervention and control groups do follow statistically significantly different trajectories over the course of Trial 1 (Figure 33).

This can be seen graphically in Figure 55. In this figure:

- Area 1 includes the UK Power Networks areas East England, London and South East England, as well as Southern England (Southern Electric Power Distribution).
- Area 2 includes the Western Power Distribution regions of the East and West Midlands
- Area 3 includes North West England (Electricity North West); North Wales, Merseyside and Cheshire (Scottish Power Energy Networks) and South Wales (Western Power Distribution)
- Area 4 includes the Northern Power Grid areas of Yorkshire and North East England
- Area 5 covers South Scotland (Scottish Power Energy Networks)



**Figure 55: Mean monthly consumption of the external control group climate regions, and Tower Hamlets intervention and control groups in 2016**

This figure illustrates both the shape of, and variation between, mean monthly electricity consumption across the DNO climate regions in Great Britain. It is important to note that the sample sizes underlying these lines vary considerably, with the five climate regions each having around ten times the numbers of participants those of the Tower Hamlets intervention and control groups. It is also possible to see the greater variation between regions over winter than summer (although the seasonal percentage variation between the regions is broadly similar).

Trial 1 observed a 3.3% savings to the intervention group relative to the control group in Trial 1. With no evidence of control group contamination effects and with intervention group behaving in a statistically similar manner to smart meter customers in each of the other climate regions across Great Britain, the observed 3.3% savings are expected to be seen in other DNO regions replicating this trial.