



# **Capturing the findings on consumer impacts from Low Carbon Networks Fund projects**

Research report for Citizens Advice  
by SE<sup>2</sup> Ltd

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## 1 Executive summary

The Low Carbon Networks Fund (LCNF) is a £500m fund managed by Ofgem that supports projects sponsored by the Distribution Network Operators (DNOs) to pilot new technology, operating and commercial arrangements. The aim is to help all DNOs understand how they can provide security of supply at value for money as we move to a low carbon economy. As a by-product, it is also the main window onto the future challenges and opportunities the smart grid will present for consumers. Yet the project outputs can be difficult to navigate and compare, and there is a risk that impacts on and key learnings for consumers will be missed. Citizens Advice commissioned this research to capture findings on consumer impacts from the most relevant LCNF projects.

### Research objectives

The objective of the research is to capture fully the findings on consumer impacts of 13 LCNF projects. This should establish:

- a) The activities each project has undertaken or plans to undertake that involve or affect domestic or small business consumers.
- b) The consumer impact of those activities, observed or expected, including financial and behavioural outcomes, experience and attitudes, problems experienced and steps taken to mitigate those problems. This should be differentiated by demographic, with an active effort to capture findings that relate to:
  - Use of prepayment meters
  - Income
  - Age
  - Family size and structure
  - Internet use
  - Disability
  - Tenant status (owners/private rental/social housing)

### Methodology

Thirteen LCNF projects were studied for this research. The projects are listed in table 1 and have been categorised according to their type: demand side response (DSR), storage / electric vehicles (EVs), energy efficiency and 'other' (substation monitoring and voltage reduction). It should be noted however that many of the projects included elements from other categories and so there is inevitable cross-over. The categories used are our understanding of the key aspects of the projects, which also helps to organise our analysis.

Table 1: LCNF Projects included in this research

Project name	Tier	DNO	Value <sup>1</sup>	Status	Expected end date
DSR					
Customer-Led Network Revolution (CLNR)	2	Northern Powergrid	£53,617,000	Completed	2014
Energy Control for House-hold Optimisation (ECHO)	1	Western Power Distribution	£350,000	Recruitment phase	2016
Energywise <sup>2</sup>	2	UK Power Networks	£5,490,000	Recruitment phase	2017
Low Carbon London <sup>3</sup>	2	UK Power Networks	£34,000,000	Completed	2014

<sup>1</sup> These values have all been agreed as correct with Ofgem as of March 2014

<sup>2</sup> Energywise was originally known as Vulnerable Customers and Energy Efficiency (VCEE): we are using 'energywise' in this report as that is the consumer facing brand. Although considered under DSR for this report, it is also trialling energy efficiency measures.

<sup>3</sup> Low Carbon London is a very broad project with multiple trials. This report only considers the smart meter and dynamic time of use tariff trials.

Storage / Electric Vehicles					
My Electric Avenue	2	Scottish & Southern Energy Power Distribution	£9,083,000	In trial	2015
New Thames Valley Vision	2	Scottish & Southern Energy Power Distribution	£29,500,000	In trial	2017
Northern Isles New Energy Solutions (NINES)	2 <sup>4</sup>	Scottish & Southern Energy Power Distribution	£15,330,000	In trial (social housing) Recruitment (private housing)	2016 <sup>5</sup>
SoLa Bristol <sup>6</sup>	2	Western Power Distribution	£2,550,000	In trial	2016
Energy efficiency projects without a price signal					
Less is More <sup>7</sup>	1	Western Power Distribution	£298,900	In trial	2015
Solent Achieving Value from Efficiency (SAVE) <sup>8</sup>	2	Scottish & Southern Energy Power Distribution	£10,338,000	Recruitment phase	2018
Other					
Ashton Hayes	1	Scottish Power Energy Networks	£200,000	Completed	2013
Customer Led Active System Service (CLASS)	2	Electricity North West	£8,084,000	In trial	2015
Smart Hooky	1	Western Power Distribution	£344,000	Completed	2013

The methodology for this research was in three stages:

### 1. Attendance at Smart Grid Forum workshops

The Smart Grids Forum ran two days of workshops in October 2014 to which selected LCNF trials were invited to present their projects. We attended these workshops as rapporteur. The themes that emerged were written up as an interim report, which also put forward research questions to explore each theme further.

### 2. Desk research

Following the workshops, we undertook desk research to form a deeper understanding of each of the LCNF projects. For each of the projects, there is a project proposal, six-monthly progress reports and a closedown report (where the project is completed). These are publicly available on the Smart Networks Portal ([www.smarternetworks.org](http://www.smarternetworks.org)) and on DNOs' own websites

### 3. Telephone interviews

The third part of the research was to carry out telephone interviews with the project leads, allowing us to delve deeper into each project and to better understand the impact they have had on consumers. The interviews were carried out over a three week period in November 2014.

To analyse the projects, we considered both cross-cutting themes - demographics, communicating with consumers, data feedback to consumers and consumer questions and complaints - and by project type - demand side response, storage and electric vehicles, energy efficiency and

<sup>4</sup> The funding mechanism for NINES is external to LCNF, although for practical purposes the governance can be considered to be a Tier 2 project.

<sup>5</sup> NINES will become business as usual as part of the Shetland Integrated Plan (enduring solution)

<sup>6</sup> SoLa Bristol also has elements of DSR and energy efficiency as well as storage (demand shifting due to system control of discharge/charge periods and use of efficient DC lighting to replace AC)

<sup>7</sup> Less is More was originally known as Community Energy Action: we are using 'Less is More' in this report as that is the consumer facing brand.

<sup>8</sup> Three of the four SAVE trials have no price signal so it has been included in the 'energy efficiency' section for this report. The fourth trial however will be testing a price signal.

community projects. We also considered questions that are very trial specific, such as the impact on consumers of being researched, decommissioning and moving to business as usual.

### Findings

The projects are extremely varied, using different innovative approaches to meet different aims for different target groups. They are also at different stages in their lifecycle - some are completed, some are mid-trial and others are in or are about to start the recruitment phase. This makes comparisons difficult in some respects, yet there are still themes that have emerged across all the projects.

The LCNF trials are demonstrating that correctly implemented smart grid solutions can work for consumers and, if put into business as usual, should deliver extensive benefits for future consumers. The final results for nine of the projects are yet to be seen but from the data available consumers on the demand side response and storage / electric vehicle (EV) trials are largely benefitting from lower bills. The results are less clear cut for the energy efficiency projects where there was no price signal but even here individual consumers should be able to benefit from reduced consumption if they take up the advice and services provided. The problem with the energy efficiency projects is whether their collective actions are enough to register at a substation level.

However, not all consumers are benefitting. All of the trials had some sort of safety net to make sure participants were not worse off than they would otherwise have been, but this is not expected to be available if the trials moved to business as usual. More work needs to be done to understand why not all consumers responded in a positive way: were they not engaged, were they shifting the wrong things, were they relying on the safety net, did their lifestyles not allow them to shift their load or did they just not understand?

Some consumers are not benefitting because they have been excluded from the trials, usually because technological solutions were not available (eg pre-payment smart meters) or because of other requirements of the trials (eg off road parking, credit checks). However, for smart grid to work for everyone, solutions must be developed for all sections of society, not just the able to pay. The results from energywise and SAVE will add significantly to the body of work in this respect and provide further insight as to how we can innovate for more vulnerable customers.

Findings from CLNR and Low Carbon London also indicate that we need to think differently about who benefits most from innovative approaches such as these: the results from both projects show at best only a weak link between income and the response to time of use tariffs. There is a much stronger correlation in Low Carbon London with size of household, although this has only been shown in terms of absolute energy shift (ie the amount of actual energy householders are using, eg in kWh) rather than relative energy shift (ie the amount of energy as a percentage of the total demand) which is the metric for CLNR. This needs to be better understood as it will feed into the way we consider demographic differences as the smart grid is developed.

The lack of demographic data, comparable or otherwise, has been a surprise in this research. The projects that are still operational should be encouraged to collect and report on this data where possible in order to help properly compare and understand the impacts of the trials on different sections of society. Where demographics have been considered, such as CLNR and Low Carbon London, the data has been valued and has impacted the way both DNOs involved in these projects will plan in the future. Complaints and consumer satisfaction data also needs to be more transparent.

Another theme across all the projects is the value of open and honest, consistent and ongoing communications. At the moment, DNOs are not set up to communicate with the public on a regular basis: they do not have strong customer relations because it is not business critical for them as things currently stand. For some of these innovative projects to move in to business as usual, DNOs will either have to shift their relationship with their customers and become more visible, or work with other delivery partners such as community advocates, energy suppliers or other third party intermediaries.

All of the DNOs tailored their messages to their target audience, and this is critical for projects such as these to succeed. Some DNOs went one step further in terms of consumer engagement and developed and trialled their messaging - everything from the project name and logo to the website and in-home display - with consumer focus groups. Communications also need to be reviewed and refreshed on a regular basis to make sure they are still working.

The communication methods varied too, from letters and emails to one-to-one outreach support. Where a communication method did not work the DNOs either tried again or tried something different, which has been a good learning outcome. Consumers increasingly access information by smart phones, but DNOs must not assume that everyone has this technology or internet access. Hard-to-reach consumers, by definition, take more effort to engage with, which takes more time and resource and is therefore more expensive. Nevertheless, it is important that these consumers are not left behind in the smart grid revolution that they help to fund through their energy bills.

These trials by their very nature have been innovative, but this has meant in some cases the technology has either not been available or not performed as hoped. Smart communications have also failed in some cases. On the other hand, however, some technology has moved on even within the lifetime of LCNF (eg substation monitoring equipment) which shows that if there is a demand the market will respond.

The visible technology in people's homes has been important in these trials and in-home displays have had a good response. Participants have responded well to systems with clear, easy to understand messages and graphics: the feedback received has been on how to simplify systems further. Linked to this is the issue of smart meter data. There were few concrete findings about willingness to share data and this needs to be understood more, especially with the impending smart meter roll out. Was it because they are early smart meter adopters that trial participants were happy for their data to be used for research, or are consumers less sensitive or less aware of what sharing their data might mean?

Only five of the projects had involvement with SMEs and the findings are inconclusive. This is an area that requires further research and development.

Although only four of the projects are finished, the interview responses and our desk research indicates that there is a place for demand side response, storage / EV and voltage reduction projects as part of a smart grid. The DNOs have made initial positive comments about the trials moving to business as usual, especially where capacity is already stretched and traditional reinforcement would be particularly expensive. Often this would require working with other partners, who would also have to benefit from the projects. The benefits to DNOs of energy efficiency projects with no price signals are less well proven: the more consumers are relied upon to take action, the more risky the project is in terms of network management.

### **Report structure**

Section 2 of the report provides background to the Low Carbon Network Fund and this research, including the objectives and methodology. Section 3 describes each of the projects, and section 4 gives a brief description of the engagement the projects have had with SMEs. Sections 5 and 6 then analyse the projects by cross-cutting themes (demographics, communicating with consumers, data feedback to consumers and consumer questions and complaints) and by project type (demand side response, storage and electric vehicles, energy efficiency and community projects) respectively. Section 7 looks at questions that are very trial specific, such as the impact on consumers of being researched, decommissioning and moving to business as usual. Our conclusions are provided in section 8.

## 2 Background

The Low Carbon Networks Fund (LCNF) is a £500m fund managed by Ofgem that supports projects sponsored by the Distribution Network Operators (DNOs) to pilot new technology, operating and commercial arrangements. The aim is to help all DNOs understand how they can provide security of supply at value for money as we move to a low carbon economy. As a by-product it also provides the main window onto the future challenges and opportunities the smart grid will present for consumers. Yet the project outputs can be difficult to navigate and compare, and there is a risk that impacts on and key learnings for consumers will be missed. Citizens Advice commissioned this research to capture findings on consumer impacts from the most relevant LCNF projects.

There are two tiers of funding under LCNF. The first tier<sup>9</sup> allows DNOs to recover a proportion of expenditure incurred on small scale projects: the second<sup>10</sup> is run as an annual competition for up to £64m to help fund a small number of flagship projects. DNOs can use the funding to explore how networks can facilitate the take up of low carbon and energy saving initiatives such as electric vehicles, heat pumps, micro and local generation and demand side management. They can also investigate the opportunities that smart meter roll out provides to network companies.

Citizens Advice, and its predecessor body Consumer Futures, has been closely involved in network innovation and the transition to smart, low carbon grids, in particular publishing *Smart Grids: Future-proofed for consumers?* (2013)<sup>11</sup> and *Take a Walk on the Demand-Side: Making electricity demand side response work for domestic and small business consumers* (2014)<sup>12</sup>. Running through this work is the Citizens Advice remit to ensure that smart grids as they develop are **affordable, accessible, safe and fair**, and that the contribution made to this by the LCNF trials, which are ultimately-consumer funded, is maximised.

### Research objectives

The objective of the research is to capture fully the findings on consumer impacts of 13 LCNF projects. This should establish:

- c) The activities each project has undertaken or plans to undertake that involve or affect domestic or small business consumers.
- d) The consumer impact of those activities, observed or expected, including financial and behavioural outcomes, experience and attitudes, problems experienced and steps taken to mitigate those problems. This should be differentiated by demographic, with an active effort to capture findings that relate to:
  - Use of prepayment meters
  - Income
  - Age
  - Family size and structure
  - Internet use
  - Disability
  - Tenant status (owners/private rental/social housing)

### Methodology

The projects are listed in table 2 and have been categorised according to their type: demand side response (DSR), storage / electric vehicles (EVs), energy efficiency and 'other' (substation monitoring and voltage reduction). It should be noted however that many of the projects included elements from other categories and so there is inevitable cross-over. The categories used are our understanding of the key aspects of the projects, which also helps to organise our analysis.

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<sup>9</sup> [www.ofgem.gov.uk/electricity/distribution-networks/network-innovation/low-carbon-network-fund/first-tier-projects](http://www.ofgem.gov.uk/electricity/distribution-networks/network-innovation/low-carbon-network-fund/first-tier-projects)

<sup>10</sup> [www.ofgem.gov.uk/electricity/distribution-networks/network-innovation/low-carbon-network-fund/second-tier-projects](http://www.ofgem.gov.uk/electricity/distribution-networks/network-innovation/low-carbon-network-fund/second-tier-projects)

<sup>11</sup> [www.consumerfutures.org.uk/files/2013/07/Smart-grids.pdf](http://www.consumerfutures.org.uk/files/2013/07/Smart-grids.pdf)

<sup>12</sup> [www.citizensadvice.org.uk/index/policy/policy\\_publications/take\\_a\\_walk\\_on\\_the\\_demand\\_side.htm](http://www.citizensadvice.org.uk/index/policy/policy_publications/take_a_walk_on_the_demand_side.htm)

**Table 2: LCNF Projects included in this research**

Project name	Tier	DNO	Value <sup>13</sup>	Status	Expected end date
<b>DSR</b>					
Customer-Led Network Revolution (CLNR)	2	Northern Powergrid	£53,617,000	Completed	2014
Energy Control for House-hold Optimisation (ECHO)	1	Western Power Distribution	£350,000	Recruitment phase	2016
Energywise <sup>14</sup>	2	UK Power Networks	£5,490,000	Recruitment phase	2017
Low Carbon London <sup>15</sup>	2	UK Power Networks	£34,000,000	Completed	2014
<b>Storage / Electric Vehicles</b>					
My Electric Avenue	2	Scottish & Southern Energy Power Distribution	£9,083,000	In trial	2015
New Thames Valley Vision	2	Scottish & Southern Energy Power Distribution	£29,500,000	In trial	2017
Northern Isles New Energy Solutions (NINES)	2 <sup>16</sup>	Scottish & Southern Energy Power Distribution	£15,330,000	In trial (social housing) Recruitment (private housing)	2016 <sup>17</sup>
SoLa Bristol <sup>18</sup>	2	Western Power Distribution	£2,550,000	In trial	2016
<b>Energy efficiency projects without a price signal</b>					
Less is More <sup>19</sup>	1	Western Power Distribution	£298,900	In trial	2015
Solent Achieving Value from Efficiency (SAVE) <sup>20</sup>	2	Scottish & Southern Energy Power Distribution	£10,338,000	Recruitment phase	2018
<b>Other</b>					
Ashton Hayes	1	Scottish Power Energy Networks	£200,000	Completed	2013
Customer Led Active System Service (CLASS)	2	Electricity North West	£8,084,000	In trial	2015
Smart Hooky	1	Western Power Distribution	£344,000	Completed	2013

<sup>13</sup> These values have all been agreed as correct with Ofgem as of March 2014

<sup>14</sup> Energywise was originally known as Vulnerable Customers and Energy Efficiency (VCEE): we are using 'energywise' in this report as that is the consumer facing brand. Although considered under DSR for this report, it is also trialling energy efficiency measures.

<sup>15</sup> Low Carbon London is a very broad project with multiple trials. This report only considers the smart meter and dynamic time of use tariff trials.

<sup>16</sup> The funding mechanism for NINES is external to LCNF, although for practical purposes the governance can be considered to be a Tier 2 project.

<sup>17</sup> NINES will become business as usual as part of the Shetland Integrated Plan (enduring solution)

<sup>18</sup> SoLa Bristol also has elements of DSR and energy efficiency as well as storage (demand shifting due to system control of discharge/charge periods and use of efficient DC lighting to replace AC)

<sup>19</sup> Less is More was originally known as Community Energy Action: we are using 'Less is More' in this report as that is the consumer facing brand.

<sup>20</sup> Three of the four SAVE trials have no price signal so it has been included in the 'energy efficiency' section for this report. The fourth trial however will be testing a price signal.

The methodology for this research was in three stages:

### **1. Attendance at Smart Grid Forum workshops**

There are close links of shared interest between the LCNF and the Smart Grids Forum, run jointly by DECC and Ofgem. Work Stream 6 of the Forum, responsible for examining the commercial and regulatory challenges of smart grids in Great Britain (which Citizens Advice attends), ran two days of workshops in October 2014 to which selected LCNF trials were invited to present their projects. We attended these workshops as rapporteur. The themes that emerged were written up as an interim report, which also put forward research questions to explore each theme further.

### **2. Desk research**

Following the workshops, we undertook desk research to form a deeper understanding of each of the LCNF projects. For each of the projects, there is a project proposal, six-monthly progress reports and a closedown report (where the project is completed). These are publicly available on the Smart Networks Portal ([www.smarternetworks.org](http://www.smarternetworks.org)) and on DNOs' own websites. Some DNO websites host further information (e.g. early learnings reports, stakeholder engagement findings, detailed data sets): many projects also have a consumer facing website (see the section 3).

### **3. Telephone interviews**

The third part of the research was to carry out telephone interviews with the project leads, allowing us to delve deeper into each project and to better understand the impact they have had on consumers. The interviews were carried out over a three week period in November 2014: details are given in Appendix 1. The topic guide for the telephone interviews is provided in Appendix 2.

### **Report structure**

Section 3 describes each of the projects, and section 4 gives a brief description of the engagement the projects have had with SMEs. Sections 5 and 6 then analyse the projects by cross-cutting themes (demographics, communicating with consumers, data feedback to consumers and consumer questions and complaints) and by project type (demand side response, storage and electric vehicles, energy efficiency and community projects) respectively. Section 7 looks at questions that are very trial specific, such as the impact on consumers of being researched, decommissioning and moving to business as usual. Our conclusions are provided in section 8.

## 3 Project descriptions

Short descriptions of the 13 projects included in this research are provided below alongside references for further information. The projects have been categorised according to their type: demand side response, storage / electric vehicles, energy efficiency and ‘other’ (substation monitoring and voltage reduction). It should be noted however that many of the projects included elements from other categories and so there is inevitable cross-over. The categories used are our understanding of the key aspects of the projects, which also helps to organise our analysis.

### 3.1 Demand side response projects

#### Customer-Led Network Revolution (CLNR)

DNO:	Northern Powergrid
Tier:	2
Value:	£52,620,000
Lead Partner:	British Gas
Academic Partner:	Durham University
Status:	Completed
End date:	2014

CLNR is one of the larger LCNF projects, aiming to find out the extent to which customers are flexible in their load and generation, and what the cost of this flexibility is. The consumer side of CLNR tests the ways in which householders respond to DSR signals when used alongside smart meters (628 participants), smart washing machines (128 participants), air source heat pumps (34 participants) and photovoltaics (PV) (250 participants). There were control groups within each sector. Data was also collected from electric vehicle owners, alongside a much wider control group of about 9,000 British Gas customers with smart meters (assumed consent with option to opt out). Static time of use tariffs were trialled with the smart meter participants; restricted hours and direct control with the smart washing machines; and time of use and direct control with the heat pumps. Premises balancing was trialled with the PV participants. All participants were able to over-ride any DSR event. Shadow billing<sup>21</sup> was in place to make sure that no consumer was worse off than they might otherwise have been on their pre-trial tariff.

The participants were initially recruited via British Gas from a pool of existing customers. The project sought to achieve a broad representation across 20 domestic customer types to mimic the general population, including socio-economic and demographic factors (age, ethnicity, socio-economic status) and socio-technical factors (diverse building stock, etc)<sup>22</sup>. For heat pumps and PV other routes had to be used (eg social housing providers) because there were not enough volunteers from the pool of British Gas customers.

The project found that consumers did shift their peak demand in response to the DSR signals: 60% of participants in the time of use trial saved money and the demand in the 4pm-8pm peak period was up to 10% lower across the trial group than the control group. It is not known whether the 40% who did not save money would have acted differently if there was no guarantee that their bills would not be more expensive. Responses to the restricted hours and direct control mechanisms were much smaller (eg only 10% of participants in the smart washing machine restricted hours trial engaged on week day evenings, and only 4% delayed their wash cycle in response to the direct control). At the end of the trial, customers were able to keep the equipment (smart meters, smart washing machines, heat pumps) but the tariff ceased.

For further information visit:

<http://www.networkrevolution.co.uk/>

<http://www.smarternetworks.org/Project.aspx?ProjectID=399>

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<sup>21</sup> Shadow billing is a mechanism to compare what a consumer’s electricity bill would have been if they weren’t participating in the trial. Most projects guaranteed participants would not be worse off and offered refunds to make up any differences.

<sup>22</sup> See Appendix 4 to the CLNR full funding submission for further details:

<http://www.networkrevolution.co.uk/project-library/optional-appendices-full-submission/>

### Energy Control for Household Optimisation (ECHO)

DNO:	Western Power Distribution (WPD)
Tier:	1
Value:	£350,000
Lead Partner:	Energy Saving Trust
Social Housing Partners:	Orbit Housing, Sanctuary Housing, Accord Housing
Status:	Recruitment phase
Expected end date:	2016

ECHO is testing responses to DSR signals in 100 private-sector and 100 social-sector homes. Each home will receive 1-3 smart plugs to be fitted to appliances with both interruptible (eg electric heater) and non-interruptible (eg washing machine) loads. A number of DSR or 'energy saving' events will take place over the course of a year to test what affects DSR success, for example when it takes place (time of day, time of week, season, elapsed time from trial start), the notice period, time between events, event duration and value of incentive. Scheduled DSR events will appear in participants' online portal which includes an 'opt out' button if they do not wish to take part: there is also an over-ride functionality on the plugs. An email with further information (eg the incentive level) for that particular event will be sent at the same time. The online portal will also enable participants to track their energy consumption and savings made: a running total of money earned will be sent out via email regularly throughout the project. The portal also allows remote access to help participants manage energy use.

The private sector participants were all subscribers to the Energy Saving Trust's e-newsletter (Energy Wire): an email was sent to all householders within the WPD area inviting them to participate. For the social housing participants, emails were sent to tenants of Orbit Housing (70 participants recruited) and letters to tenants of Sanctuary Housing (4 participants recruited) and Accord Housing (5 participants recruited).

For further information visit:

<http://westernpowerinnovation.co.uk/Tier-1-Projects/ECHO.aspx>  
<http://www.smarternetworks.org/Project.aspx?ProjectID=1199>

### Energywise (Vulnerable Customers and Energy Efficiency - VCEE)

DNO:	UK Power Networks
Tier:	2
Value:	£5,490,000
Partners:	British Gas, Bromley by Bow Centre, Tower Hamlets Homes, Poplar HARCA, Institute for Sustainability
Academic Partner:	University College London
Other Partners:	CAG Consultants, National Energy Action
Status:	Recruitment phase
Expected end date:	2017

Energywise aims to engage with fuel poor households in an area of Tower Hamlets, London to understand how they can benefit from energy efficiency and participate in DSR, quantify the network service these customers could provide and understand the challenges and best approaches to engage with this group of customers. 550 households will be involved in the two-phase project. In the first phase (trial 1), 275 householders will be provided with a smart meter, in-home display and some low cost energy efficiency items (eg eco kettles and LEDs) to assess their level of response to smart meters and energy saving devices: the other 275 householders will act as a control group. In trial 2, the control group will be given the package of measures and then all households will be invited to switch to a time of use tariff: time-shift devices (eg smart plugs) will also be provided. This will also help to test how consumers respond to getting a smart meter at the same time as switching to a time of use tariff (rather than as staggered events). The DSR signal and time of use tariff will be designed based on the learnings from trial 1: shadow billing and refunds will be provided if the tariff is punitive. Participants can withdraw from the project at any time. The project will also be trialling a Multiple Dwelling Unit Shared Infrastructure to enable smart meter installations in otherwise ineligible buildings: this has the potential to address 5% of the UK's housing stock.

The recruitment phase is about to begin. All participants invited to participate in this project will be British Gas customers, tenants of Tower Hamlets Homes or Poplar HARCA, and live in a home with an energy rating of C-G. UK Power Networks is working closely with Bromley by Bow Centre to engage and recruit households in the project: they have recruited a team of Customer Field Officers who will do the outreach work and support the participants throughout the trial.

For further information visit:

<http://www.smarternetworks.org/Project.aspx?ProjectID=1324#project-details>

<http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Vulnerable-Customers-and-Energy-Efficiency/>

### Low Carbon London

DNO:	UK Power Networks
Tier:	2
Value:	£36,060,000
Lead Partners:	EDF, CGI, Siemens
Academic Partner:	Imperial College London
Status:	Completed
End date:	2014

The aim of Low Carbon London is to test options for a future where electric vehicles, smart meters and local generation are commonplace. It is wide in scope, including monitoring of on-street electric vehicle charge points<sup>23</sup> and real-time network management solutions in the industrial and commercial sector. The focus of this Citizens Advice research however has been on the dynamic time of use tariff, the first of its kind in Britain. A dynamic time of use tariff (dToU) provides different tariffs in response to different network events, for example if the network is at peak (constraint management) or if there is surplus supply when it is windy (supply following): in a static time of use tariff, like in CLNR, the tariffs are always the same every day.

5,600 smart meters were installed in homes across 10 Low Carbon Zones in London, 1,100 of which were switched to the dynamic time of use tariff (the other 4,500 became the control group): extensive work was undertaken to get a demographically balanced sample so this could be extrapolated to represent Greater London. The intervention group received a DSR signal 24 hours before the tariff change ('day ahead') via their in-home display (and SMS if they opted in) to inform them if a block of time the following day would be a high (67.20p/kWh) or low (3.99p/kWh) tariff. Each high or low price event lasted 3, 6, 12 or 24 hours: the rest of the time the participants were on a medium tariff (11.76p/kWh). The control group were on a fixed rate tariff of 14.23p/kWh, which is more expensive than the trial 'medium' tariff. Constraint management and supply following signals were both tested.

Recruitment was carried out by EDF (an energy supplier) from their customer base via email and the EDF website. The intervention group were then approached again by letter and phone call to invite them to switch to the dynamic time of use tariff. Certain groups who were thought might be disadvantaged from a dynamic time of use trial were excluded from the project, eg pre-payment meter customers and those on the Priority Services Register (PSR). Dual fuel, Economy 7 and those with installed microgeneration were also excluded. UK Power Networks guaranteed to reimburse any consumers who were worse off at the end of the trial.

The dToU trial ran for a full twelve months through 2013: 95% of households saved money relative to what they would have spent had they been on the standard flat rate tariff. Peak reduction varied on average from 5% to 10%, with a stronger response in the winter compared to the summer. The Low Carbon London final report states that 91% of participants endorsed the dToU tariff, 81% said it should be a standard tariff for everyone, and 79% said it was not complex: the questions that were asked in order to get these responses are discussed in section 6.1 below. At the end of the trial, the dynamic time of use tariff ended and consumers reverted to their original tariff.

For further information visit:

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<sup>23</sup> A short summary of the findings from the electric vehicle charge point monitoring is given in section 6.2.

<http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-%28LCL%29/>  
<http://www.smarternetworks.org/Project.aspx?ProjectID=400>

### 3.2 Storage / electric vehicle projects

#### My Electric Avenue

DNO:	Scottish & Southern Energy Power Distribution (SSEPD)
Tier:	2
Value:	£9,083,000
Lead Partner:	EA Technology
Academic Partner:	De Montfort University, University of Manchester
Status:	In trial
Expected end date:	2015

My Electric Avenue aims to simulate the electricity network as it might be in 2030, by which time there is expected to be an extra strain on the system caused by the anticipated increased uptake of electric vehicles. There are two parts to the project. In the technical trial, 100 consumers<sup>24</sup> in clusters of 7-10 consumers connected to the same substation have been recruited to lease a Nissan Leaf electric car at reduced cost. Charging points have been installed in their homes, alongside an innovative control mechanism (called 'Esprit') which monitors and controls the electricity demand for the charge, balancing it with other demands on the local network to avoid overloading individual cables. All the cars are expected to be fully charged by each morning, but Esprit manages the load so they will not all take the charge at the same time: safeguards are in place should cars not be charged when needed (eg emergency engineer, reimbursement of taxi fares).

Householders were recruited through the project website and by poster/radio advertising in the DNO licence area. Those who expressed an interest were then encouraged to become 'cluster champions' and sign up neighbours to participate too as multiple participants connected to the same local substation were required. Recruitment also took place via the existing networks of the car lease and charge point providers.

The second part of the project is the social trial, which is the control group. 120 consumers<sup>25</sup> have signed up to lease a Nissan Leaf (with a smaller discount than the technical trial offer) and to have their charging and travel patterns monitored, but with no control over charging and no requirement to be in a cluster of consumers.

For further information visit:

<http://myelectricavenue.info/>

<http://www.smarternetworks.org/Project.aspx?ProjectID=415>

#### New Thames Valley Vision

DNO:	Scottish and Southern Energy Power Distribution (SSPED)
Tier:	2
Value:	£27,230,000
Academic Partner:	University of Reading
Status:	In trial
Expected end date:	2017

New Thames Valley Vision is a broad project based in Bracknell consisting of demand response, cold thermal storage and energy storage/management for the industrial and commercial sector, and hot thermal storage and low voltage (LV) network monitoring for the domestic sector. A pop-up advice centre ("Your Energy Matters") also operated in Bracknell town centre for 18 months. 31 private-sector homes that already have PV installed have been recruited to trial a smart thermal storage device (called 'EMMA') which diverts excess electricity generated by the panels at peak times to the hot water immersion. This means the householders are using more of their generated electricity in their home and reducing their hot water heating costs on their gas bills. The project

<sup>24</sup> Numbers correct as of March 2015

<sup>25</sup> Numbers correct as of March 2015

has also installed and is collecting data from end point monitors in 250 other homes, which helps the DNO to visualise the network. These householders are invited to VIP events every 3-6 months at which point they can request their data on a CD. They also receive 6-monthly project updates.

Bracknell Forest Council provided SSEPD with a list of all the local homes with PV. Those with an array of the right size were then invited to participate by letter and follow-up door-knocking. Of the approximately 150 PV systems in the right area, about 65 surveys were carried out and 31 EMMA units installed. The end point monitor householders were signed up through newspaper advertising, mailing campaigns and the advice centre. There was also local visibility of the project officer in local communities. At the end of the project, the end point monitors will be removed: a decision is yet to be made on the EMMA units.

For further information visit:

<http://www.thamesvalleyvision.co.uk/>

<http://www.smarternetworks.org/Project.aspx?ProjectID=396>

### Northern Isles New Energy Solutions (NINES)

DNO:	Scottish and Southern Energy Power Distribution (SSEPD)
Tier:	2 <sup>26</sup>
Value:	£34,950,000
Partners:	Hjaltland Housing Association, SGS, Airwave
Academic Partner:	University of Strathclyde
Status:	In trial (social housing); recruitment (private housing)
Expected end date:	2016 <sup>27</sup>

The NINES programme aims to balance the Shetland Isles demand and generation, allowing more renewable generators to connect to the grid whilst informing the Island's future energy solution, including the replacement of Lerwick's diesel fuelled power station. The part of NINES considered within this research is the demand side management (DSM) project, which is trialling the effectiveness of space and water heating for managing demand by installing smart storage heaters and hot water tanks in 234 social sector homes (where the heating systems were installed by the landlord and partially funded through the European Regional Development Fund (ERDF)) and the development and implementation of a sustainable model which is expected to see DSM rolled out into a further 500 homes (where the heating systems will be privately financed).

The DSM works by sending a series of control signals to manage the times that the space and water heating devices will receive their electrical charge. The times sent are the times which are optimum for the network, whilst ensuring the devices receive or already hold enough energy to meet the consumers' needs at any given time. Consumers continue to use their heating and water system as normal, setting the temperature and the times they require the heat. The charge could happen at any time during a 24 hour period depending on the needs of the network (rather than overnight as is the case on multi rate tariffs such as Economy 7). SSEPD suggest to consumers that they switch from their current multi-rate (Economy 7 type) tariff to a single rate tariff. This is because there is not currently a tariff available nationally or regionally which would support the dynamic DSM time pattern: remaining on Economy 7 (or similar) could mean that consumers are billed at a more expensive peak rate for heating and water usage.

The social housing homes were pre-selected by the housing association as part of their retrofit programme, whilst recruitment of the social housing participants was done directly by SSEPD and supported by the NINES Development Officer, who was trained to answer any direct queries from consumers on the operation of the new heating systems. The private sector participants are being recruited directly by SSEPD through a combination of local events, their website and direct calls

SSEPD has committed that no consumer will be worse off for taking part in the DSM project having switched to a single rate tariff, even when it becomes business as usual. SSEPD will pay consumers the difference between the (new) single rate and (old) multi rate tariff (which is about 5p/unit) for

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<sup>26</sup> The funding mechanism for NINES is external to LCNF, although for practical purposes the governance can be considered to be a Tier 2 project.

<sup>27</sup> NINES will become business as usual as part of the Shetland Integrated Plan (enduring solution)

heating and hot water units for all participants. This is expected to avoid the need for further reimbursements, although shadow billing can be set up on request. Private households will also be paid an incentive of £50/year for as long as they remain in DSM: social housing tenants receive a one-off £100 payment 6 months after the equipment is installed.

About half of the social housing participants are on pre-payment meters (PPM), with a very small number being on the Priority Services Register (PSR). Special care will be taken with regard to these particular consumers. SSEPD will not switch dynamic DSM scheduling for PPM or PSR consumers until enough usage data is collected to ensure that they will not be worse off and their credit is not used when they do not expect it

For further information visit:

<http://www.ninessmartgrid.co.uk/>

<http://www.smarternetworks.org/Project.aspx?ProjectID=403>

### SoLa Bristol

DNO:	Western Power Distribution
Tier:	2
Value:	£2,484,000
Lead Partner:	Knowle West Media Centre (KWMC), Bristol City Council, Siemens
Academic Partner:	University of Bath
Status:	In trial
Expected end date:	2016

SoLa Bristol is supporting 30 social sector homes (as well as a number of schools and an office block) in Bristol to test how a DNO can respond to multiple PV installations on one local network. Bristol City Council (the landlord) has paid for and installed PV on all the homes in the project. WPD have then installed batteries with demand response in each home to store excess generated power, as well as direct current (DC) lighting systems and USB charge points<sup>28</sup>. Storing PV generation locally in batteries, instead of exporting into the distribution network, allows customers to make the best use of their own generation as well as reducing the impact of PV on the distribution network. Consumers also receive a tablet so they can access their generation and demand, battery charge, weather and potential financial savings. Eight tariff scenarios have been developed to test how customers alter their demand profile using the automated Low Voltage (LV) Connection Manager, battery storage, micro generation or lifestyle changes.

Participants were engaged through outreach work (door knocking, known networks (eg groups and schools), open days, fliers and posters, Facebook, word of mouth) by Knowle West Media Centre and then filtered for eligibility (eg house orientation, size of roof, space for batteries). Knowle West Media Centre has continued to offer hand-holding support to all the participants throughout the trial.

Householders are already noticing a reduction in their electricity bills, both because of the PV installed and because of the batteries: one person has reported that their weekly spend has halved from £20/week to £10/week. Most of the participants are on pre-payment meters (PPM). Some participants did not realise that their PPM had run out as the DC lights, which run off the storage battery rather than the mains, stayed on: KWMC addressed this through additional messaging, reiterating that householders should keep an eye on their meters to avoid the battery being run down. The Feed-In Tariff payment goes to the landlord but WPD is mimicking this in a further payment direct to the participants for the duration of the trial. At the end of the project all equipment will be decommissioned except the PV as this has been installed by and is owned by Bristol City Council. The householders will be able to keep the tablets.

For further information visit:

<http://westernpowerinnovation.co.uk/So-La-Bristol.aspx>

<http://kwmc.org.uk/projects/solabristol/>

<http://www.smarternetworks.org/Project.aspx?ProjectID=394>

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<sup>28</sup> DC is the form of electricity provided by batteries. Each participating house in SoLa Bristol has a micro-grid installed that runs off the batteries and can be used to charge mobile phones and other USB devices.

### 3.3 Energy efficiency projects with no price signal

#### Less is More (Community Energy Action)

DNO:	Western Power Distribution (WPD)
Tier:	1
Value:	£434,565
Lead Partner:	Centre for Sustainable Energy (CSE)
Supporting Partners:	Community Energy Plus, Marches Energy Agency, National Energy Foundation, Severn Wye Energy Agency
Status:	In trial
Expected end date:	2015

Less is More sees five energy charities help 10 different communities reduce their electricity use, especially at peak times. The communities are based around distribution substations, which is where the monitoring takes place. Participants can see their community's performance on the project website which shows electricity use over time and use today, with targets for bringing down peak demand. By reducing their electricity use and/or shifting it to off-peak times, the householders attached to each substation can earn up to £5,000 to improve their neighbourhood; the running totals are also available online.

WPD and CSE selected about 15 substation 'communities' which would be suitable for the trial (eg in WPD area, geographically suitable for the energy charities, mainly domestic load, no off-gas, no large PV load) which the energy charities could then choose from. Engagement locally has been through a number of routes including door-knocking and leaflet drops, slow cooker demonstrations, pop-up stalls and focussed campaigns (eg wash at 30°, 7 minute switch off at 7pm).

For further information visit:

<http://www.lessismore.org.uk/>

<http://www.smarternetworks.org/Project.aspx?ProjectID=421>

#### Solent Achieving Value from Efficiency (SAVE)

DNO:	Scottish and Southern Energy Power Distribution
Tier:	2
Value:	£10,338,000
Academic Partner:	University of Southampton
Status:	Recruitment phase
Expected end date:	2018

The aim of SAVE is to establish to what extent energy efficiency measures can be considered a cost effective, predictable and sustainable tool for managing demand on electrical networks as an alternative to traditional reinforcement. Approximately 3000 consumers will be recruited across three different trials and have their household electrical demand monitored to test their ability to shift or reduce peak demand. Trial one will test the provision and uptake of LED lighting. Trials two and three will be part of an engagement campaign based on the monitored data and will provide contextual information so householders can see what their electricity consumption means: smart plugs will also be provided to monitor appliances with moderate-high demand (they do not provide any automation). Trial three participants will additionally receive DNO price signals in the form of a rebate. There will be no in-home displays but participants will be able to access their data on a web portal: those without internet access will be provided with paper literature. Recruitment is due to start in January 2015. A market research agency is developing a randomised, stratified approach to ensure a good cross-section of consumers take part, with a focus on ensuring socio-economic and demographic data is captured. There will also be a control group of approximately 1000 consumers.

A fourth trial will also take place to test a community coaching approach, split across two geographical trial areas and two geographical control areas with 1,000 consumers in each<sup>29</sup>. One control and one intervention community will be in more affluent areas; the other control and intervention group will be in a more disadvantaged area. A paid community champion will be in

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<sup>29</sup> Community coaching has been assessed by SSEPD before as part of an IFI project in Melksham. See <http://www.ssepd.co.uk/Innovation/IFIAndRPZ/> for further details.

post for the duration of the project to give local support and advise householders how to be more energy efficient.

For further information visit:

[http://www.ssepd.co.uk/Innovation/  
www.smarternetworks.org/Project.aspx?ProjectID=1325](http://www.ssepd.co.uk/Innovation/www.smarternetworks.org/Project.aspx?ProjectID=1325)

### 3.4 Other projects

#### Ashton Hayes Smart Village

DNO:	Scottish Power Energy Networks (SPEN)
Tier:	1
Value:	£200,000
Lead Partner:	Ashton Hayes Community Energy CIC, EA Technology
Status:	Completed
End date:	2013

Ashton Hayes is a village in rural Cheshire with the ambition to become England's first carbon neutral village. They had already done a lot of work to reduce their carbon footprint and in 2010 received funding through DECC's Low Carbon Communities Challenge. Through the LCNF project, SPEN assisted Ashton Hayes with the next stage in their journey, using it as an opportunity learn how a DNO can facilitate the connection of low carbon technologies without jeopardising the network and to better engage with communities. Advanced power quality instruments were installed within the low voltage (LV) network to measure the village's combined consumption and the contribution distributed generation was making. Regular community reports kept residents updated and informed.

The community engagement work was considered a success and SPEN is now regularly consulted on village plans that may impact on the network. SPEN built relationships with residents through a series of community meetings and a dedicated communications. Residents were also asked to complete a number of surveys to help with the data analysis (eg appliances survey, occupancy levels, heating types).

A final survey asked what actions residents had taken during the project as a proxy for raised awareness. The close down report states: *'Measuring the impact of engagement within Ashton Hayes however was proven to be very difficult because the outcomes can be intangible and there are a number of drivers from inside and outside the project that change people's behaviour and attitudes. In addition Ashton Hayes was already a very aware community and therefore most of the 'quick hits' in terms of efficiency and behaviour change had already occurred. The impact might therefore be less than in the average community.'* Specific work was carried out with the village shop to help them identify why their electricity bills were high. The planned DSR trial did not take place due to a delay in the roll out of smart meters.

For further information visit:

[http://www.goingcarbonneutral.co.uk/  
http://www.smarternetworks.org/Project.aspx?ProjectID=382](http://www.goingcarbonneutral.co.uk/)

#### Customer Load Active Systems Services (CLASS)

DNO:	Electricity North West (ENW)
Tier:	2
Value:	£8,084,000
Lead Partner:	Impact Research
Academic Partner:	University of Manchester
Status:	In trial
Expected end date:	2015

CLASS seeks to demonstrate that electricity can be managed by controlling voltage without any discernible impacts on customers. 60 of ENW's primary substations are participating in the scheme, affecting about 300,000 customers or 15% of their network. All customers in the trial area were

written to about the project. Voltage events will take place over a 12 month period from April 2014.

Four focus groups were recruited, each with about 10 participants, to help develop the project leaflet, brand and customer surveys. A further 700 customers (500 domestic and 200 business customers, including a pilot and control group) have been recruited (through the leaflet) to respond to seasonal questionnaires about their perceptions of the voltage changes. The baseline survey took about 20 minutes and the four follow up surveys will take about 5 minutes each. All surveys take place over the phone and customers can earn up to £150 if they participate in all of them. Results to date have shown no statistically significant change in reported appliance behaviour: some customers have reported a perceived change even when they are in the control group or before voltage events have taken place.

For further information visit:

<http://www.enwl.co.uk/class>

<http://www.smarternetworks.org/Project.aspx?ProjectID=413>

#### **Smart Hooky (Hook Norton Low Carbon Community Smart Grid)**

DNO:	Western Power Distribution
Tier:	1
Value:	£344,000
Lead Partner:	Hook Norton Low Carbon Club, National Energy Foundation
Status:	Completed
Expected end date:	2013

Hook Norton is a rural community in Oxfordshire with around 2,500 residents and 800 properties, which in 2009 was awarded £400k from DECC's Low Carbon Communities programme to help its residents 'decarbonise'. Smart Hooky was set up to help WPD understand how a rural community uses electricity at different times of the day and to find out how electricity networks could accommodate more low-carbon technology. Monitoring equipment was installed at 11 substations alongside 46 load monitoring nodes at customer meter points, with data published on an online portal. The original target of 150 smart node installations was largely not met due to lack of space: delays in the online portal could also have affected consumer interest.

Householders were recruited to have the smart nodes installed through a variety of channels, including community meetings, newsletter, leaflets and, when the substations were agreed, door-knocking and a prize draw. Hourly consumption data from six monitored substations can be seen on the Smart Hooky website. Customers with smart nodes can also log in to see their personal consumption data. The portal's overall usefulness was impacted by incomplete data sets. The close down report states: *'We have no direct evidence to suggest that customer behaviours and energy usage was altered as a result of this project. However the presence of the website and publicity associated with the project will increase awareness in the village of energy related issues.'*

At the time the project began, there was no commercially available monitoring equipment and so WPD had to develop their own innovative systems and protocols. The technology has moved on quickly and any future substation monitoring installed by WPD use off the shelf solutions.

For further information visit:

<http://www.hn-lc.org.uk/>

<http://www.smart-hooky.net/>

<http://westernpowerinnovation.co.uk/Tier-1-Projects/Smart-Hooky.aspx>

<http://www.smarternetworks.org/Project.aspx?ProjectID=380>

## 4 SMEs

As well as looking at the impact of the LCNF projects on domestic customers, the research objective for this work also included impacts on small business customers. This is a much smaller subset of the 13 projects, and the findings have been less clearly reported. As such, the following section provides an overview of activity rather than analysis of impacts. Some of the projects are also part of a wider endeavour by the DNO that also includes industrial and commercial (I&C) customers (eg Low Carbon London and the wider NINES project).

Five of the projects include activities specifically for small or medium-sized enterprises (SMEs). However, it should be noted that the definition of ‘SME’ includes organisations with fewer than 250 employees and a turnover of less than €50 million (or about £37 million)<sup>30</sup> which is actually quite a large entity, accounting for 99% of all private sector businesses in the UK<sup>31</sup>. The projects do not differentiate between medium, small and micro businesses.

The five projects are as follows:

**CLNR:** The CLNR customer trials involved about 2,000 SME, I&C and distributed generation customers. Basic profiling was carried out for 1,514 SME customers: enhanced profiling was carried out with 80 British Gas SME customers with smart meters. From the surveys and interviews, CLNR found that

*...most SME trial participants think reducing energy use is important (72%), but most have no environmental policy or don't know whether they have one (90%). Some have sought professional energy advice (32%).<sup>32</sup>*

Another 80 SME customers were signed up to a static time of use tariff. However, because SMEs are so different from each other, no comparisons could be drawn:

*Because of the heterogeneity of the participants, any comparative assessment is only possible by comparing the performance of the same SME with and without the ToU tariff. Unfortunately, we had such data for only one SME... Although few conclusions on the impact of ToU tariffs on SMEs can be drawn from this example, there is clearly an interest from SMEs in ToU tariffs and so further work would be useful. However, it demonstrates the need, because of the heterogeneity of the SME community, to conduct monitoring both with and without the ToU tariff for the same SME.<sup>33</sup>*

CLNR had extreme difficulty in signing SMEs up to the restricted hours and direct control trials. Over 20,000 SMEs were approached and a significant number had technical site surveys, but only about 50 went ahead. This was mainly because the uncertainty introduced by potential interruptions in electricity supply was unacceptable to the business process, even though there was a high level of interest in demand side management as a concept:

*SMEs showed significant reluctance to flex their electricity use and disrupt their business activities. Relative to their size, this reluctance was arguably the most marked and it demonstrated that DNOs will have to develop new, potentially bespoke methods, to engage with this heterogeneous customer group. For those that did participate in the trials, reduced demand was satisfactorily demonstrated during the peak period.<sup>34</sup>*

**CLASS:** all of the customers on ENW's 60 primary substations will automatically participate in the trial, which includes about 1500 commercial customers. 200 businesses also form part of the DNO's customer panel to respond to seasonal surveys. A ‘frequently asked questions’ fact sheet for

<sup>30</sup> [http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index\\_en.htm](http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_en.htm)

<sup>31</sup> <http://www.fsb.org.uk/stats>

<sup>32</sup> See p70 <http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/small-customers-L2-report-v0-9.pdf>

<sup>33</sup> Ibid, p74

<sup>34</sup> See p6: <http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/CLNR-G026-Project-Closedown-Report-2301152.pdf>

businesses who participated in the surveys is available at <http://www.enwl.co.uk/docs/default-source/class-documents/frequently-asked-questions---business-customers.pdf?sfvrsn=2>.

**New Thames Valley Vision:** as part of this project, SSEPD have automated demand side response (DSR) agreements in place with 30 small commercial customers, which include smart meters and end point monitors. There is also widespread network monitoring of over 300 substations which includes 252 small commercial customers alongside 33,000 domestic customers. Reading University will use the data to simulate future network behaviour and assess the extent to which this modelling technique is appropriate for light commercial customers (eg high street shops, garages, hairdressers). The DNO will also assess the extent to which response solutions for large commercial customers, such as building management systems (BMS), can effectively be applied to smaller businesses.

**SoLa Bristol:** the PV panels, storage batteries and DC lighting systems are being installed in four schools, Knowle West Media Centre offices and a Bristol City Council office.

**Ashton Hayes:** the village shop was part of the Ashton Hayes trial and also benefitted from bespoke energy efficiency advice which resulted in them changing the way in which they stocked and used their chiller cabinets.

The learning from this is that small businesses are largely being overlooked in DNO innovation projects. Only CLNR and CLASS include SMEs at scale, and of these only in CLNR do they need to be pro-active (as the impacts of the voltage changes in the CLASS trials should be non-discernible to customers). This is clearly an area that needs more work, especially, as identified in CLNR, as they are such a heterogeneous group.

## 5 Findings by theme

This section looks at cross-cutting themes of the LCNF projects and compares how each DNO has responded.

### 5.1 Demographics

The projects each had different target audiences depending on their objectives. Most projects were focused within the DNO network area ('in area'), although some cast the net wider where target numbers of participants could not otherwise be met or where large control groups were required (eg smart meter data for CLNR). Two projects (energywise and SoLa Bristol) focussed on low income households whereas others had a mix (eg ECHO and NINES). There were no pre-payment customers in Low Carbon London (smart PPMs were not available when the trial began) or My Electric Avenue (no PPM consumers applied, although other project criteria would have excluded some householders (eg requirement for off-road parking and a credit check)).

Three projects - Low Carbon London, CLNR and CLASS - reported using detailed protocols in order to make sure their test base included a representative cross-section of society (albeit for Low Carbon London and CLNR with exclusions where there was potential for consumer detriment such as customers on pre-payment meters). In CLNR, Durham University developed detailed demographic profiling of participant types across all their 22 test-cells that had to be filled, which included age, income, tenure, rurality and type of property. Low Carbon London used Acorn classifications<sup>35</sup>: their final report uses three broad socio-economic groupings for their analysis - affluent, comfortable and adversity<sup>36</sup>. CLASS set overall quotas when recruiting their panel of customers who are invited to respond to seasonal questionnaires. For domestic customers, quotas were set on age, gender and social grade to be representative of the North West region, although these are clustered in targeted specific areas to ensure there are enough consumers to allow robust analysis. Table 2 summarises the key demographic features of each of the projects participants.

**Table 3: Demographic features of project participants**

	Location		Housing		PPM	Other factors
	In DNO area	Beyond DNO area	Private sector	Social housing		
<b>DSR</b>						
CLNR	✓	✓	✓	✓	✗	Heat pump installs through social landlords
ECHO	✓		✓	✓		100 private sector, 100 social housing
Energywise	✓			✓	Mostly	Tower Hamlets. English as second language. C-G energy performance rated homes. Customers on pre-payment meters.
Low Carbon London	✓		✓	✓	✗	
<b>Storage / Electric Vehicles</b>						
My Electric Avenue	✓	✓	✓			Credit check, lease agreement, off-road parking
New Thames Valley Vision	✓		✓			Bracknell. Existing PV owners

<sup>35</sup> Acorn is a consumer classification that segments the UK population. See <http://acorn.caci.co.uk/> for further details.

<sup>36</sup> The LCL final report can be found at <http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-%28LCL%29/>

NINES	✓		✓	✓		Shetland 234 in social housing trial Recruiting 500 other consumers directly
SoLa Bristol	✓			✓	Mostly	Knowle West (Bristol)
Energy efficiency projects with no price signal						
Less is More	✓		✓	✓		Mix of community types
SAVE	✓		✓	✓		Solent region
Other						
Ashton Hayes	✓		✓	✓		Ashton Hayes, Cheshire
CLASS	✓		✓	✓		
Smart Hooky	✓		✓	✓		Hook Norton, Oxfordshire

## Findings

In their final report, Low Carbon London reflect on the observed difference in response to the dynamic time of use (dToU) tariff at peak demand depending on the household size and ACORN group, with larger households providing responses in larger magnitudes (see section 6.1). This knowledge of demographics:

*... highlights the benefit of knowing an area's demographic and consumers' behaviour and the increasing importance of having smart-metering data to enable informed planning decisions.<sup>37</sup>*

The key findings from our research with regard to demographics are:

- If possible, a demographic reporting requirement should be added to the LCNF projects that are still live. Reporting on demographics should also be a requirement of any future funding frameworks. For most of these LCNF projects, little is known about the participants and that represents a gap in knowledge. This may be a reflection of where the projects are in their life-cycles: the most detail comes from CLNR and Low Carbon London, two of the biggest projects and the ones that have most recently published their final reports. My Electric Avenue said an academic paper by De Montfort University will be available about the demographics of the project. In the interviews, respondents from both SoLa Bristol and Less is More explained that detailed demographic data was not available. While this is not the primary reason for collecting the data, by not collecting this data DNOs are missing a crucial trick in understanding why people respond the way they do. It also makes comparisons between projects very difficult.
- In the CLNR final report it has been suggested:

*Identifying traditional socio-economic groups for commercial propositions may not be appropriate. Instead, it may be most appropriate to focus on 'socio-technical' groups (eg customers with high income, large houses and 2+ fridges) or different kinds of 'flexibility capital' (eg shift workers, those with dishwasher that can be programmed).<sup>38</sup>*

The idea that we need a different way of thinking about consumers and how they consume energy should be investigated further as other projects come to a close and report their findings. Details on how different demographic groups have responded to the different project approaches - as far as data is available - is provided in section 6.1.

- Within this however, we must not lose sight of vulnerable consumers: socio-economic considerations are still important. Some projects have excluded vulnerable consumers in order to protect them, for example CLNR and Low Carbon London have excluded customers on pre-payment meters and participation in My Electric Avenue required a credit check in order to

<sup>37</sup> See p39: <http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-%28LCL%29/Project-Documents/LCL%20Learning%20Report%20-%20SR%20-%20Summary%20Report%20-%20DNO%20Guide%20to%20Future%20Smart%20Management%20of%20Distribution%20Networks.pdf>

<sup>38</sup> See p65: <http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/small-customers-L2-report-v0-9.pdf>

lease the EV. On the other hand, energywise will focus on consumers that are in or at risk of fuel poverty and/or on prepayment meters. SAVE may also include consumers on PPM. SoLa Bristol focuses on the social housing sector. NINES also includes consumers on PPM. They are being cautious, collecting and analysing data before they switch their PPM and PSR participants to the flexible charging regime and it will be interesting to see the results of this analysis. Further investigation is required to fully understand if and how low income consumers will respond and/or benefit from these types of projects.

## 5.2 Communicating with consumers

### Recruiting participants

Engagement methods to recruit participants varied across the projects, depending on their target audience and scale of the project. Table 3 summarises the primary engagement methods used.

**Table 4: Primary engagement methods used by the projects to recruit participants**

	Letter	Email	Phone	Door knocking	Outreach	Other / notes
<b>DSR</b>						
CLNR	✓		✓			British Gas recruitment; social landlords
ECHO	✓	✓				
Energywise	✓		✓	✓	Customer Field Officers	Website; drop-in events
Low Carbon London	✓		✓			
<b>Storage / Electric Vehicles</b>						
New Thames Valley Vision	✓			✓		Project officer presence in the local area
My Electric Avenue				✓	Cluster Champions	Website; partner networks; radio
NINES	✓				Development Officer	Website; community events
SoLa Bristol	✓		✓	✓	2 outreach workers	Facebook, school gates, open day, word of mouth, stalls at events, fliers, posters
<b>Energy efficiency projects with no price signal</b>						
Less is More				✓	5 energy charities	Also working with other local groups (eg housing association, community council). Using events, school gates stands, local fairs/fetes, existing drop-in centres, flyer drops.
SAVE	✓			✓	Community coach	Market research agency carrying out recruitment
<b>Other</b>						
Ashton Hayes					Pro-active residents	Low carbon village - community pull
CLASS	✓					Assumed consent
Smart Hooky				✓	Pro-active residents	Low carbon village - community pull. Community events. Prize draw

In some projects, consumers were already engaged in some way in the low carbon agenda, making them more receptive to the idea of participating in a trial. The ECHO private-sector participants have been engaged via the Energy Saving Trust's (EST) 'Energy Wire' e-newsletter, to which they

are all signed up. Promotion for My Electric Vehicle was mostly done through existing green transport networks / websites. Both CLNR and New Thames Valley Vision recruited householders with existing PV installations. CLNR also recruited householders to their time of use tariff who already had a smart meter installed.

Projects targeting customers traditionally less interested, aware or able to engage in this sort of scheme (the 'hard to reach') need a much more personal approach: see 'outreach and community engagement' below.

### Ongoing engagement

Keeping participants engaged throughout the life of the project was seen by all DNOs as critical to success. All of the projects kept the participants informed about the project to different degrees, depending on the type of project. Table 4 summarises the ways in which DNOs continue this engagement process.

**Table 5: Methods used for ongoing engagement**

	Letter	Email	Phone	Door knocking	Outreach	Other / notes
<b>DSR</b>						
CLNR	✓	✓				DSR signals via smart appliances
ECHO	✓	✓				
Energywise	✓	✓	✓		Customer Field Officers	Home visits (if requested by an eligible customer); drop-in centre; energy report with smart meter installation
Low Carbon London	✓					dToU signals via SMS and in home displays (IHD)
<b>Storage / Electric Vehicles</b>						
My Electric Avenue	✓	✓				
New Thames Valley Vision	✓					Local drop-in / advice centre
NINES	✓	✓	✓		Development Officer	Website; community events; post install visits; newsletters
SoLa Bristol	✓	✓	✓		2 outreach workers	Regular visits, focus groups, local newsletter, website, e-bulletins
<b>Energy efficiency projects with no price signal</b>						
Less is More				✓	5 energy charities	See table 3 - and also monthly newsletters, prize draws, giveaways of energy saving equipment, text messaging
SAVE	✓			✓	Community coach	Web portal for messaging and viewing data
<b>Other</b>						
Ashton Hayes	✓	✓			Pro-active residents	Low carbon village - community pull
CLASS	✓					Assumed consent
Smart Hooky	✓	✓			Pro-active residents	Low carbon village - community pull

The projects with a more intense hand-holding approach had frequent face-to-face intervention points whereas the larger projects tended to update consumers less regularly and in written or electronic format (eg Ashton Hayes used quarterly newsletters, Low Carbon London had monthly feedback letters with personal consumption data). DNOs reported increased activity after these updates or reminder communications were sent out.

Some consumers were also engaged on a more regular basis as part of the trial research, for example to complete interviews and surveys. Those involved in demand side response trials also received regular signals from the DNO (section 6.1).

All the projects have their own websites for further information<sup>39</sup> as well as leaflets, posters, etc where appropriate. The community based projects also undertook outreach work (see below and also section 0).

### **Outreach and community engagement**

The smaller and more geographically focussed the project, the more personal the level of engagement is. This is particularly true of energywise and SoLa Bristol, both of which are targeting low income households. Intensive outreach and hand-holding approaches were (or will be) adopted in both of these projects, an expensive approach that was felt necessary to reach those who would benefit most from the project. In the SoLa Bristol community, there are very high levels of illiteracy and so lots of visuals were used in the promotion work: word of mouth has also been a strong route as lots of families have been in the area a long time and have their own local networks. Outreach workers ran open days, did home visits, helped to arrange installation visits and were there to answer any questions / deal with any maintenance issues or concerns the householders had. In energywise, a team of Customer Field Officers has been recruited by the local community centre to lead the outreach work, many of whom are multi-lingual to match the needs of the local residents. They will also have a translation sheet when they approach householders door-to-door. A female Field Officer is also available should one be requested. NINES also have a project development officer although the support they offer is less intense.

Less is More also adopted an outreach approach in engaging their 10 communities to reduce their energy consumption and shift their peak load. However, in these communities the ‘trusted parties’ were less well known than in SoLa Bristol and energywise: they were environment charities who came to the community specifically to run the project, although some have also worked with trusted local intermediaries (eg housing associations, community council). The engagement methods varied according to the needs of each community and the experience of the charity, but included pop-up stalls, slow cooking demonstrations and door-knocking.

Ashton Hayes and Smart Hooky were also community based projects. In these cases, the DNO got involved with the existing low carbon action groups to provide the village residents with monitoring data. My Electric Avenue relied on pro-active residents, including those willing to become ‘cluster champions’ who were prepared to promote the project and actively recruit neighbours on to the trials. New Thames Valley Vision established a high street advisory centre in Bracknell (“Your Energy Matters”) which operated for 18 months.

### **Assumed consent**

Two of the projects operated on the basis of assumed consent for participation: CLASS for their voltage events and CLNR for smart meter data from their control group.

CLASS aims for the voltage events to be indiscernible to their consumers, which has been supported in their findings so far. Small voltage changes happen all the time, the difference here is the lower thresholds that are being trialled. In CLNR, however, the assumed consent is different as it involves the provision of data. Almost no consumers chose to opt out of the control group and it would be interesting to find out more about this. Was it because they are early smart meter adopters and so are happy for their data to be used for research, or are consumers less sensitive or less aware of what sharing their data might mean?

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<sup>39</sup> All project websites are given in the project descriptions in section 3.

## Digital communications

As summarised in tables 3 and 4, the LCNF projects used a variety of methods to engage with consumers both at the beginning of the trials and on an ongoing basis. Information about all of the projects was also available online via either a specific website or the DNO's main site.

Only one project - ECHO - has relied almost entirely on email to recruit participants to the trial (rather than letters). The private sector participants were already signed up to the EST's e-newsletter and so were sent an invitation to participate through this route. The EST worked with three social housing providers to engage with their tenants, and one of these only used email communications with 70 people signing up. However, this approach raises the risk that householders either without email or who have not shared their email address with their social housing provider will miss out on the offer. The other two housing providers wrote letters to their tenants but the response was poor: of the 300 letters sent to Sanctuary Housing tenants only three replies were received. A follow up letter generated an additional eight replies but not all were appropriate for the trial, bringing the final count to four. The project team has taken this to mean that email invitations elicit a much stronger response than letters.

The implications of internet access for monitoring data and feedback are discussed in the in-home displays section below (section 5.3).

## Brand and knowledge of the DNO

All the interviewees were in agreement that consumers do not know what a DNO is, but were also of the opinion that, until now, there has been no reason for them to know: the public tend to only engage with their DNO if there's a power cut. However, if DNOs continue to extend their operations into consumer-facing activities such as those trialled through LCNF, this will become more of an issue.

This very low level of knowledge and awareness lead to a number of approaches by the DNOs. All of them explained who the DNO was and who was funding the project but in some projects this came later in the explanation than for others. For example, Electricity North West lead the recruitment for CLASS, writing to all customers in the trial area and enclosing a leaflet to explain more about the project, whereas for ECHO the lead was taken by the EST or the social housing provider as they had the existing relationship with the consumer. For CLNR, most of the recruitment was carried out by British Gas, again because they had an existing consumer relationship. Across all projects, the project name became an important part of the engagement, as beneath this all the project partners could be included.

When the projects explained the role of the DNO to consumers they usually used language such as 'we keep the lights on' or compared them to similar network providers such as Network Rail. They also explained about network capacity and the need to shift peak demand in language suitable to their audience. Consumers understood this in basic terms, though often confused the DNO with their energy supplier and had not appreciated there were different organisations. This was more of a problem for DNOs who shared a name with an energy supplier, eg Scottish and Southern Energy Power Distribution, than for those that did not, eg Northern Powergrid.

## Findings

As part of UK Power Network's preparation for the communications plan for energywise, they reviewed best practice for consumer engagement across the other LCNF projects. The findings are summarised in the energywise Communications Plan for Pilot Study and Project Trials<sup>40</sup> and cover:

- Staff and installer checks and skills
- Local partners
- Data sharing protocols
- Identifying potential participants
- Maximising recruitment and minimising drop out
- Communication and interaction with residents
- Providing compensation and incentive payments

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<sup>40</sup> [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Vulnerable-Customers-and-Energy-Efficiency/Project-Documents/VCEE\\_Communications+Plan+for+Pilot+Study+and+Project+Trials+\\_v1.3+LM+050....pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Vulnerable-Customers-and-Energy-Efficiency/Project-Documents/VCEE_Communications+Plan+for+Pilot+Study+and+Project+Trials+_v1.3+LM+050....pdf)

The LCNF projects studied for our research included some or all of the best practices identified by UK Power Networks. Each project adopted an approach that was appropriate for the types of audience they wanted to reach. There were some cases where the target numbers of participants were not reached and so alternative methods were used: for example in CLNR the project team had to look beyond the British Gas client base to meet the PV and heat pump targets, and in ECHO they are having to work with multiple registered social landlords in order to reach their social tenant participation target.

In some cases, some parts of the trials had to be either downsized or abandoned because of technology issues: for example in Smart Hooky fewer metering nodes were installed than anticipated because of a lack of space to install them in people's homes. They were also trying to recruit high numbers from a very small pool of consumers which was very challenging: data transmission issues also reduced the project's reach.

The key findings from our research with regard to communications are:

- Communications should be open and honest, and especially during research and development projects such as these. Consumers want to know what is happening: they are more likely to understand delays if someone explains why it has occurred. Ongoing communications also help to keep consumers engaged and involved in a project.
- Messages used to engage with consumers varied enormously across the projects, depending on their aims and audiences: some DNOs focussed on money saving messages, but others included 'reduce your energy use', 'do your bit for the planet' or 'be part of a community endeavour'. The key is that messages must be targeted and reviewed on a regular basis to make sure they are still working. Further analysis of the CNLR and Low Carbon London findings may reveal the extent to which consumer responses peaked following communications or waned during the trial: how do we ensure behaviour change is maintained?
- Consumers do not necessarily know who or what a DNO is but that doesn't matter, for now at least. Much effort went into each project brand. Best practice is for these to be developed and/or tested with the target audience, eg through focus groups.
- DNOs do not have strong relationships with their client base. Many of the projects recruited from the customer base of partner organisations which helped to short-cut the recruitment process (eg through EST's e-newsletter for ECHO, through British Gas customers for CLNR and through EDF customers for Low Carbon London).
- Reaching the hard-to-reach is difficult. Outreach work is the most effective route to engaging with consumers who are usually outside of projects such as these, and that takes time and money. It's a real investment. Working with existing well-known and trusted organisations in the local area increases the potential for success.
- Assumed consent is a sensitive issue, especially when it comes to sharing data. It took careful consideration from Ofgem to allow CLNR to assume consent for smart meter data usage but has resulted in no complaints from either that project or from CLASS. Smart data is of great value to DNOs to help them understand and plan future network demands, but with smart meters still in their infancy this is still largely untested grounds and benefits to consumers still need to be explored.
- Providing participants a safety net for the trial, ensuring they will not be any worse off than had they not participated in the trial, was a critical part of the offering. Further thought needs to go in to how these consumers would have responded if the safety net had not been there, or how the safety net could work in the open market, as this will impact on any decisions for DNOs to move the trialled products and approaches into business as usual.
- Many of the projects relied on digital communications at some point. With the rise of smart phones, more people are using mobile internet than fixed line broadband, particularly amongst

low income households (which will have other implications for smart homes)<sup>41</sup>. However, there are still concerns that consumers without an internet connection at home - 4 million households in 2014, including the majority of people aged over 65 living alone<sup>42</sup> - will miss out on the smart grid if internet technologies are overly relied upon because they just will not know about the projects that could benefit them. This is one of the main concerns raised around participation in smart energy programmes by the research of the Smart Grid Consumer Collaborative in the US<sup>43</sup>.

### 5.3 Data feedback to consumers

#### Smart meters and in-home displays (IHDs)

Smart meters were used in CLNR and Low Carbon London, and will be installed in energywise. All three of these projects are demand side response and are testing consumer responses to a signal, provided through the smart meter or by text message (SMS)<sup>44</sup>. Smart appliances (washing machines) were also tested in CLNR and in-home displays were used for the PV and TOU trial participants. ECHO is using smart plugs. Their signal will come via the online portal and email: the email includes more detailed information (eg incentive levels for that event) designed to inform participants' decisions, although consumers can opt out only via the portal.

Where IHDs have been used in the LCNF projects they have had a good response:

*The IHD was found to be clear and useful for acting on rate changes.*<sup>45</sup>

Some improvements were suggested though: in the case of Low Carbon London, participants feedback that a traffic light display on the IHD showing which tariff level was in operation (low, middle or high) would have been helpful. They also wanted to know why different tariffs were being put in place: not knowing gave rise to suspicions that the DNO was just profiteering<sup>46</sup>.

Figure 1: the in-home display from CLNR



<sup>41</sup> See p45: <http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/small-customers-L2-report-v0-9.pdf>

<sup>42</sup> <http://www.ons.gov.uk/ons/rel/rdit2/internet-access---households-and-individuals/2014/stb-ia-2014.html#tab-Household-Internet-Access>

<sup>43</sup> <http://smartgridcc.org/wp-content/uploads/2014/05/Spotlight-4.10-non-member-summary.pdf>

<sup>44</sup> Trial one of energywise will just be energy efficiency: trial 2 will be energy efficiency and DSR combined

<sup>45</sup> See p33: <http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-%28LCL%29/Project-Documents/LCL%20Learning%20Report%20-%20SR%20-%20Summary%20Report%20-%20DNO%20Guide%20to%20Future%20Smart%20Management%20of%20Distribution%20Networks.pdf>

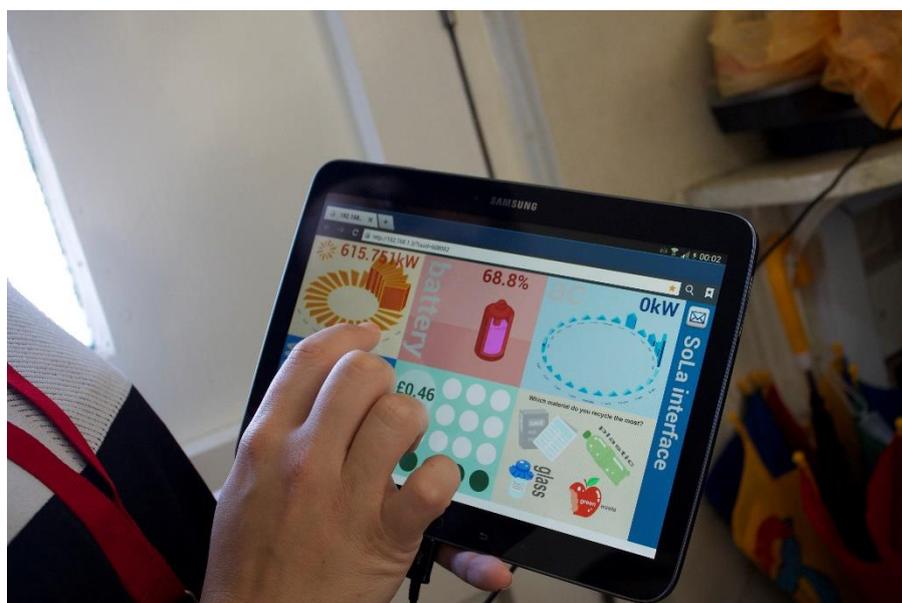
<sup>46</sup> Ibid

Although SoLa Bristol did not use smart meters, they did give each of the participants a tablet with 1GB/month data so they can access information about their solar generation, battery charge, electricity demand and savings. The interface for the tablets was designed by a community artist working at Knowle West Media Centre alongside some of the participants:

*[The tablet design was] positively received due to its easy to understand configuration. Customers appreciated the use of simple to understand graphics to convey information.<sup>47</sup>*

The tablets are also being used to ask the participants survey questions. Two videos with feedback from householders on the data are available at <http://lowcarbonuk.com/lcuk/articles/73-sola-bristol-videos>. SoLa Bristol reported in the interview that they have seen a drop in interest in the project when there have been problems with the data feed: data provided on the tablets helps to keep householders engaged.

**Figure 2: The SoLa Bristol in-home display on a tablet**



In the other storage / EV projects (NINES, My Electric Avenue and New Thames Valley Vision), in-home displays were not used. In these projects the consumer role is passive once they have agreed to participate in the project: they do not have to make decisions or respond to a signal - the storage / EV system is intelligent and takes this decision on their behalf.

### Online portals

The two energy efficiency projects with no price signal - Less is More and SAVE<sup>48</sup> - provide data through an online portal<sup>49</sup>. For Less is More, data is shown against targets for the whole community: our electricity use over time, our electricity use today, how much money have we earned (see figures 2 and 3 below and also <http://www.lessismore.org.uk/>). The SAVE portal will provide data at a household level set in context so the consumer understands what it means.

<sup>47</sup> See p12: <http://www.westernpowerinnovation.co.uk/Document-library/2014/DecLearningReport2014-v1-3-MD.aspx>

<sup>48</sup> One of the four SAVE trials is testing a price signal.

<sup>49</sup> Trial one of energywise will also investigate energy efficiency with no price signal in preparation for trial 2, where energy efficiency and DSR will be combined.

**Figure 3: Our electricity use over time from the Less is More portal**

**Widget 1 | Our electricity use over time**

This graph shows the electricity use from this substation over time – specifically the past few days. The horizontal axis shows the time of day, while the vertical axis shows the amount of electricity (in kilowatt-hours, or kWh, to be precise) being used by all the homes attached to the substation. Notice how the power demand ‘peaks’ in the mornings and evenings.

To earn money for their community, the households need to help bring the peaks down below the blue dotted line. They can do this by, say, having fewer lights on, or by shifting their energy use to ‘off-peak’ times – by running dishwashers and washing machines in the middle of the day rather than in the evening, for example. If everyone does this, the overall electricity use will end up looking more like the green line. This is a good thing for the people who distribute our electricity, and they will reward the community for its efforts.

It’s possible that you will occasionally see gaps in the pink line. This happens when we are having difficulty collecting the data from the substation monitoring equipment due to technical challenges (e.g. intermittent radio signal). We do our best to account for the missing data during these gaps by estimating those missing values from the recent data.

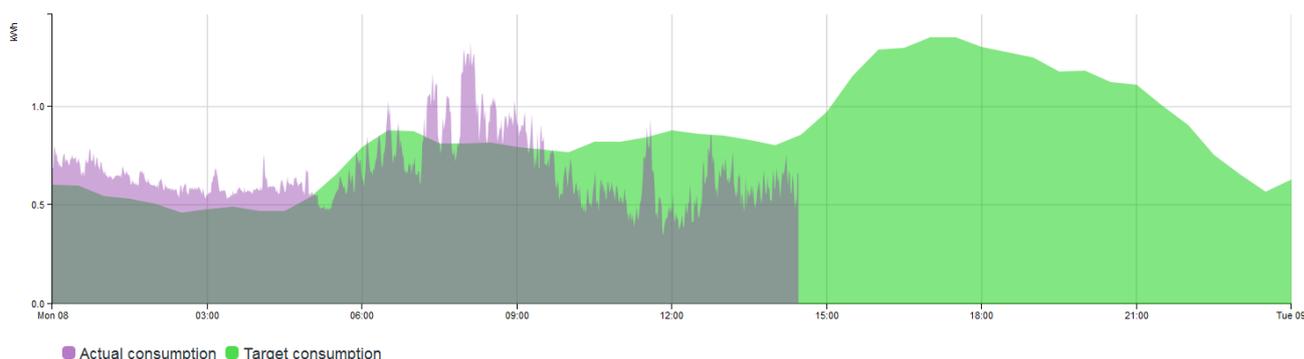


**Figure 4: Our electricity use today from the Less is More portal**

**Widget 2 | Our electricity use today | Monday, 08 December 2014**

This graph shows the amount of electricity used so far today in the homes attached to this specific substation, and how much we’re likely to use by the end of the day (midnight). The green accumulator shows the target amount that we should be aiming for.

This information is live, the actual consumption updates every minute. If you see more green than purple you are on track!



Less is More have reported the following website use across all 10 communities:

- 1,916 users<sup>50</sup>
- 4,578 sessions<sup>51</sup>
- 16,279 page views

Community pages with the most unique views vary from 1,169 for Loughton (a fairly affluent semi-rural village setting: fewer young families, mostly couples with adult children) to 372 for Silverdale (a very low income community in privately owned or privately rented accommodation: education achievement levels are lower than average). Ely, a similar area to Silverdale, is the largest substation with 350 consumers: they had 503 unique views. However, the smallest substation, Bournville with 92 consumers (low income social housing with significant right to buy private ownership: education achievement levels are lower than average) had 548 unique visits which suggests the penetration of the project in this community is much wider. Each of these four communities is working with a different environmental charity: it will be interesting to see comparisons in the final report as to why these differences occurred.

<sup>50</sup> Users that have had at least one session. This includes both new and returning users.

<sup>51</sup> A session is the period time a user is actively engaged with a website. All usage data (Screen Views, Events, Ecommerce, etc.) is associated with a session.

CSE, the project lead for Less is More, is also working with an entrepreneur to develop an in-home display that provides feedback from a substation level, called the Greenbank Energy Monitor (GEM). The device is being trialled in 23 homes and will send a signal during the peak 'challenge period' for consumers to reduce or shift their load.

**Figure 5: The Greenbank Energy Monitor**



The two pictures above show the GEM in-home display: the picture on the left when there is no challenge active (showing 'Next challenge starts at 7.26pm', 'Reward earned to date £4232' and '5 households played yesterday'), and the picture on the right when there is ('Time remaining 2 minutes' and '3 out of 50 households have joined in'<sup>52</sup>.) The simple graph on the right hand picture shows total consumption at the substation compared to the 'limit' (the peak demand) that the householders are challenged to stay beneath..

Smart Hooky and Ashton Hayes also provided monitoring data to householders in each village. In Ashton Hayes, this was through a regular newsletter. In Hook Norton, the plan was for all residents to access <http://www.smart-hooky.net/> to see substation level data and for those with a smart node installed to log in to see their own consumption data. However, there were various issues with the transmission of the data which meant this feedback data was not available. In the final report, NEF (the stakeholder engagement partner) explains:

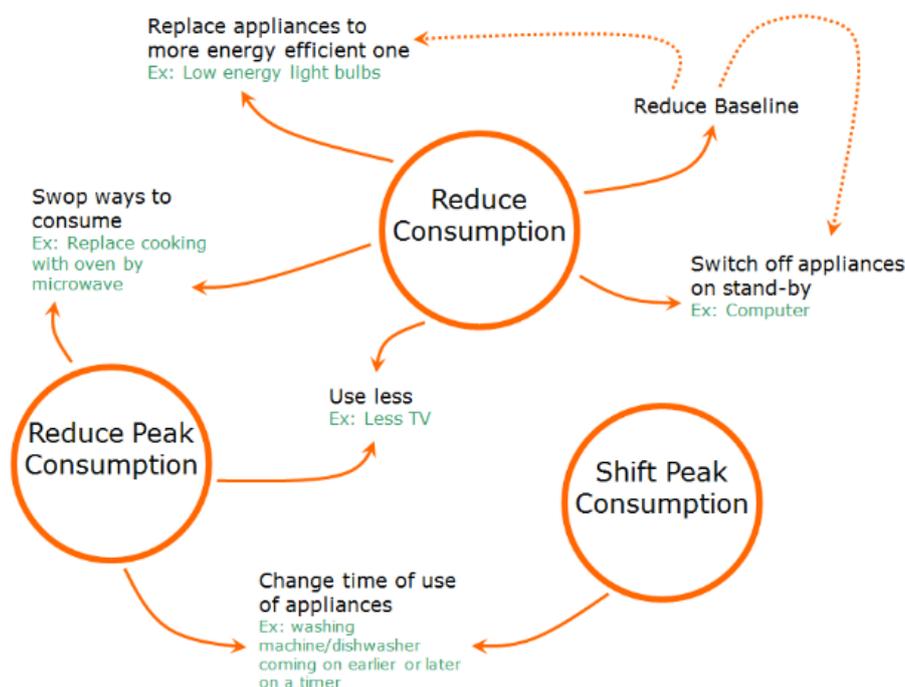
*Whilst we were ready to engage with more residents, the issues with data transmission put a halt to any further recruitment. Various technical issues had been found relating to the operation of the equipment which reduced confidence in the data and we felt it was difficult to recruit any more participants without being able to show to the residents what data they would see and interact with.<sup>53</sup>*

These problems meant it took nearly a year before the website was ready for householders to use. A workshop was held to re-engage participants, to which about half of the group attended. Although numbers were low, ideas were put forward as to how the participants thought they might be able to use the data:

<sup>52</sup> ie 3 people have pressed the button to show that they know it is a challenge period and they are intending to reduce demand.

<sup>53</sup> See p59: <http://www.westernpowerinnovation.co.uk/Document-library/2014/Tier-1-Hook-Norton-Close-Out-Report-Dec-2013-Final.aspx>

Figure 6: How Smart Hooky participants might use their feedback data<sup>54</sup>



When asked which actions they would do at peak times and which they would do all the time, participants said they would mostly do things all the time. NEF take from this that “residents either didn’t understand the purpose or found it too complicated to change a habit specifically at peak time.”<sup>55</sup>

Problems with the data continued to effect the project. Data gaps meant some participants’ feedback was unreliable, showing either very high peaks or very low consumption: this was seen as a major element in the project being less successful than anticipated.

### Findings

In one of the CNLR documents that supports the final reports it states:

*54% agreed or strongly agreed that IHDs had caused them to change the time they used some electrical appliances... 90% found IHDs quite or very easy to understand.*<sup>56</sup>

The key findings from our research with regard to data feedback to consumers are:

- A feedback loop to consumers is essential to keep consumers engaged and to help ensure they maintain their ‘good energy behaviour’, be that shifting their peak load or reducing their consumption. As the learning from Smart Hooky demonstrates, it is important to have complete data.
- The trials have used newsletters, IHDs and online portals to provide feedback. Each has its use dependent on the aim of the communication: for example a newsletter for community communications or an IHD for instantaneous unprompted feedback.
- The feedback mechanism and interface - be it on an IHD or via a website - need to be easy to understand. The graphics used on the SoLa Bristol system are excellent and were developed

<sup>54</sup> Ibid, p62

<sup>55</sup> Ibid, p62-3

<sup>56</sup> See p44: <http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/small-customers-L2-report-v0-9.pdf>

with the users themselves. Simple 'at a glance' systems - such as the traffic lights suggested for Low Carbon London's IHD - are also to be encouraged, although it needs to be made clear whether for example a red light means high usage or high tariff. Some participants in the SoLa Bristol trial suggested that an app could also be developed for use on smart phones, but this should not replace IHDs.

- Not everyone has internet access and if other routes to data are not explored these consumers will miss out: free online access has only been provided as part of the project by SoLa Bristol (although even here there have been some problems with the reliability of the mobile signal). For New Thames Valley Vision, monitoring data is provided to consumers with end-point monitors on a CD on request (though this still requires them to have a computer on which to read the CD): although this gets round the online issue it feels clunky and unresponsive. The project also held face-to-face sessions for participants where they offered to tailor data in response to individual requests.

#### 5.4 Consumer questions and complaints

At the LCNF workshops in October and in the interviews, the projects were asked for feedback on the types of questions or concerns participants had, or if any complaints had been made.

Complaints have been very few and are more visible in the projects with deeper outreach support because there are fewer participants, they are better known to the project workers and there is more opportunity for them to discuss the project (what is going well as well as things that are not going so well). In SoLa Bristol for example, there was a delay between householders signing up to the project and the equipment being installed which caused some complaints. Knowle West Media Centre handled these and strived to keep all participants up-to-date with changes in the timetable. Later in the project, some participants did not realise that their PPM had run out as the DC lights, which run off the storage battery rather than the mains, stayed on: KWMC addressed this through additional messaging, reiterating that householders should keep an eye on their meters to avoid the battery being run down.

Consumers had questions before the trials began and in several cases the DNO provided a Frequently Asked Questions fact sheet to help pre-empt some of these queries (eg ECHO and CLASS). In My Electric Avenue, there were a lot of questions about the electric vehicles and the lease agreement, such as range and clarity that there were no hidden costs. Queries across other projects have included whether their home is suitable for inclusion in the trial and when and in what form the cash/voucher incentives will be paid. Once installed, some consumers also had questions about the new equipment (eg how to use the new storage heaters in NINES) and this was dealt with on a case by case basis, sometimes with a home visit.

Of the larger scale projects, Low Carbon London and CLNR are both working closely with an energy supplier (EDF and British Gas respectively) and so complaints could be made directly to their call centres. These were then passed back to the project team where appropriate. In CLASS, the Electricity North West call centre will be notified every time a voltage event takes place so any complaints can be cross-referenced.

CLNR used the number of drop-outs from the ToU trial as a metric for dissatisfaction with the project. These were not definite complaints: there may have been other reasons for their departure such as change of tenancy or supplier. The numbers of drop-outs and the reasons given are shown in table 5 below.

**Table 6: Reasons for participants leaving the CLNR ToU trial<sup>57</sup>**

Time of Use drop out reasons	Number of drop outs	% of drop out total
Cost/lifestyle peak hours usage	49	30.43%
Only wanted a smart meter	44	27.33%
Too much hassle	17	10.56%
Change of supplier	14	8.70%
No communications post installation	8	4.97%
Change of tenancy	7	4.35%
Did not like Terms and Conditions	5	3.11%
Fitting of prepayment meter	5	3.11%
Handover from another channel - no reason provided	5	3.11%
Ill health	3	1.86%
Rarely at home	2	1.24%
Elderly	1	0.62%
Test cell change (ToU Tariff to Solar)	1	0.62%
Grand Total	161	

SoLa Bristol also reported a number of drop outs from the project, due mainly to people moving house which is seen as a particular risk amongst tenants compared to owner occupiers. There are two cases however where this has not been the case:

*On the other hand, one household decided to leave the project after phase one, as they were unhappy with the potential location of the equipment within their house. The location was discussed and alternative options suggested, but ultimately the householders chose to withdraw from the project. Finally, one household was asked to leave the project, as their behaviour to project members was inappropriate and placed project members at risk.<sup>58</sup>*

### Findings

Complaints about the trials themselves seem to have been very small, and well within the normal expected level. DNOs have systems in place to deal with complaints, and where issues have arisen they have been dealt with swiftly.

The key findings from our research with regard to customer complaints are:

- As indicated in our findings of how to engage with consumers, open and honest communications are best. If participants know what is happening and why, they are less likely to complain.
- When complaints do arise, they should be dealt with swiftly and to the satisfaction of the consumer. Bad news travels fast and to not deal with issues could be a reputational risk for DNOs. This will particularly be the case if and when some of these innovative ideas such as ToU tariffs become the norm and are more in the public eye.
- Special care should be taken with vulnerable consumers. Knowle West Media Centre in the SoLa Bristol project has been exemplary in hand-holding participants through every step of the process, providing support and answering any concerns. This has often meant multiple phone

<sup>57</sup> This table has been provided by Northern Powergrid. The table on p100 of <http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/small-customers-L2-report-v0-9.pdf> shows that 161 customers dropped out pre-trial (as on table 5). However, it also shows that of the 682 customers that were activated there were only 570 at the end of the trial - which is a drop out of another 112. Northern Powergrid are currently investigating this further with British Gas.

<sup>58</sup> See p11: <http://www.westernpowerinnovation.co.uk/Document-library/2014/DecLearningReport2014-v1-3-MD.aspx>

calls and home visits, discussions and reassurances. The duty of care on the DNO has also been high because the measures installed have been intrusive and have required multiple visits. This one-to-one support however is expensive. It will be interesting to see the findings of the energywise project as they move from recruitment to operational phase.

- DNOs should be open with information with complaints, which they may be reticent to do. However, only by sharing information on complaints and drop-outs can we collectively learn how and why consumers respond the way they do.

## 6 Findings by approach

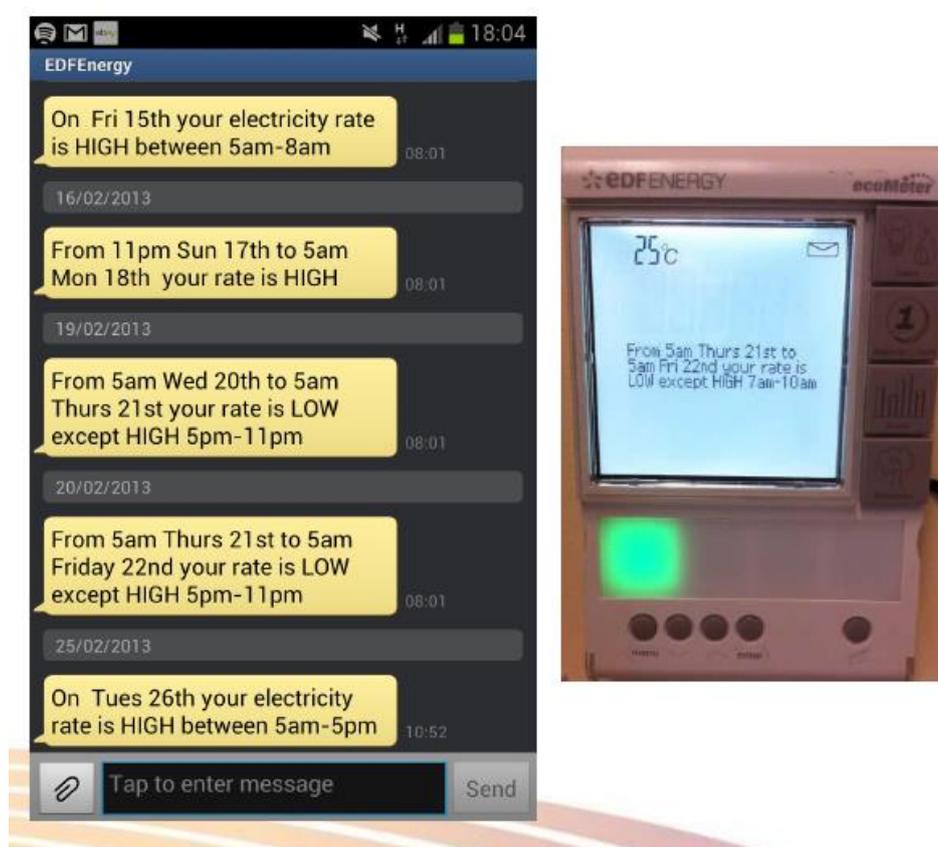
### 6.1 Demand side response

Of the four DSR projects, CLNR and Low Carbon London have recently finished: their final reports and numerous supporting documents were published for comment during January 2015 (final versions will be published three months after close down). The other two projects - ECHO and energywise - are in or are about to commence the recruitment phase and so responses are not yet known.

#### How the DSR signal is sent

The DSR signal is given in different ways. For Low Carbon London, the day-ahead signal was sent 24 hours before via the in-home display and SMS, to inform participants if a block of time the following day would be a high (67.20p/kWh) or low (3.99p/kWh) tariff. Each high or low price event lasted 3, 6, 12 or 24 hours: the rest of the time the participants were on a medium tariff (11.76p/kWh).

Figure 7: Examples of the Low Carbon London SMS and IHD signals



In CLNR the ToU tariff was static, so once consumers had signed up to the trial the tariffs were always at the same time so there was no need for a regular signal. Participants were told at the beginning of the trial what the new tariff would be and this was confirmed in writing by their energy supplier (British Gas). The tariff was constructed so consumers would have 20 hours of reduced rate electricity per day:

Weekend:	31% below standard rate
Night time 8pm-7am:	31% below standard rate
Peak 4pm-8pm:	99% above standard rate
Daytime 7am-4pm:	4% below standard rate

However, a dynamic test was used in CLNR both with wet white goods and heat pumps with a thermal store. In the restricted hours trials, the signal appeared on the smart washing machine

itself telling consumers that they were in a high tariff period and asking if they wanted to delay the appliance use. In the direct control trials, during the network constraint event the smart washing machine would display a message saying that an event had been called and asking consumers to delay use. Consumers were able to override the signal if they wanted their wash to start straight away. There was also an override function on the heat pump trial.

ECHO will send the signal to participants via email and through the online portal, each time trying a different level of incentive. Participants will be able to opt out each time using the online portal. They will also be able to override the smart plugs during the event. The energywise time-of-use tariff is part of their trial two and will be developed during trial one once participants' usage profile has been captured.

#### **How consumers benefitted**

Both CLNR and Low Carbon London found that consumers did shift their peak demand in response to the DSR signals.

60% of CLNR participants in the time of use trial saved money and the demand in the 4pm-8pm peak period was up to 10% lower than the control group. It is not known whether the 40% who did not save money would have acted differently if there had been a safety net (ie a guarantee that their bills would not be more expensive than if they had not participated in the trial).

Responses to the restricted hours and direct control mechanisms were much smaller. Only 10% of participants in the smart washing machine restricted hours trial engaged on week day evenings, and only 4% delayed their wash cycle in response to the direct control. This is significantly lower than the findings from the University of Cambridge public opinion survey of 2010 where 65% of people said they would be willing to shift washing after 9pm in response to a ToU tariff<sup>59</sup>.

Monitoring data and demographic analysis across the CLNR project showed that:

*The only statistically significant link with customer consumption and demographics was in relation to income, and even there the correlation was weak... The next major factor appears to be house efficiency.<sup>60</sup>*

In terms of customers who responded directly to the ToU tariff, the CLNR project discovered:

*The only statistically significant demographic correlation to the ToU tariff was housing tenure (renter/home owner) and the presence of dependents in the household. Homeowners and households without dependents were more likely to respond to the ToU tariff than renters and those with dependents.<sup>61</sup>*

In the Low Carbon London final summary report, it was reported that 95% of households saved money relative to what they would have spent had they been on the standard flat rate tariff. However, it should be noted that the 'standard' rate used as a comparison was calculated such that an average consumer<sup>62</sup> would break even relative to the standard even if they made no change to their behaviour, so the only way to lose out would be to have unusually high peaks of usage to start with or to actually shift behaviour actively in the wrong direction<sup>63</sup>. The finding that only 5% of participants were in this situation is therefore less reassuring than it might appear. Low Carbon London's own analysis includes another methodology for calculating the proportion of savers,

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<sup>59</sup> See p39: [http://www.eprg.group.cam.ac.uk/wp-content/uploads/2014/01/EPRG-WP-1122\\_Complete.pdf](http://www.eprg.group.cam.ac.uk/wp-content/uploads/2014/01/EPRG-WP-1122_Complete.pdf)

<sup>60</sup> See p9: <http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/small-customers-L2-report-v0-9.pdf>

<sup>61</sup> Ibid, p16

<sup>62</sup> That is, a consumer sticking completely to the daily profile 1 usage profile as defined by Elexon <https://www.elexon.co.uk/reference/technical-operations/profiling/>

<sup>63</sup> See p49: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A3%20-%20Residential%20consumer%20responsiveness%20to%20time%20varying%20pricing.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A3%20-%20Residential%20consumer%20responsiveness%20to%20time%20varying%20pricing.pdf)

arguably more accurately, which showed that only 75% would have saved<sup>64</sup> (for example, the 95% figure is mentioned in the final project summary document but the 75% figure is not)<sup>65</sup>.

Peak reduction in Low Carbon London varied on average from 5% to 10%, with a stronger response in the winter compared to the summer. 91% of participants endorsed the dToU tariff, 81% said it should be a standard tariff for everyone, and 79% said it was not complex. The project team also developed a measure of responsiveness to establish the extent to which savings on the dToU could be due to chance. However, the Low Carbon London reports fail to make it adequately clear that the questions were phrased in a way that obviously might influence responses: 'if it encourages more efficient use of electricity and resources, multi-rate tariffs like Economy Alert should be offered to everyone' and 'if it is a fairer way of charging people for the real cost electricity at different times, multi-rate tariffs like Economy Alert should be the standard tariff for everyone'<sup>66</sup>. It was also not explained to respondents that the shadow billing safety net would be removed outside the trial<sup>67</sup>.

Again, the Low Carbon London findings are that there are only weak links between responsiveness and demographics:

*Perhaps surprisingly, the socio-economic class had no significant effect on the observed demand response for these single events, although results from constraint management events suggest that households in the Affluent class may respond more strongly to signals that specifically target peak hours. The measured response does depend strongly on occupancy levels, with larger households providing responses of larger magnitude. An apparent exception is formed by the larger (3+) Adversity households, which do not exhibit a significantly larger response than the lower occupancy households, although this finding is only marginally significant.<sup>68</sup>*

This is a different finding to both CLNR and the Element Energy report of April 2014 'Further Analysis of Data from the Household Electricity Usage Study: Electricity Price and Demand Response':

*The Energy Demand Research Project EDF trials showed that the peak demand shifting effect of a ToU tariff was, on average, negligible for households with more than three occupants (aged 16-64).<sup>69</sup>*

This difference could be explained in part because Low Carbon London looks at absolute shift (ie the amount of actual energy householders are using, eg in kWh) whereas CLNR is looking at relative shift (ie the amount of energy as a percentage of the total demand). Larger households usually have higher consumption and so there is more to shift. However, it is not clear how much they are shifting as a percentage of their total usage.

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<sup>64</sup> Ibid, p51

<sup>65</sup> [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20SR%20-%20Summary%20Report%20-%20DNO%20Guide%20to%20Future%20Smart%20Management%20of%20Distribution%20Networks.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20SR%20-%20Summary%20Report%20-%20DNO%20Guide%20to%20Future%20Smart%20Management%20of%20Distribution%20Networks.pdf)

<sup>66</sup> The first two points under 'Main findings on consumer attitudes to dToU' in Low Carbon London's Summary Report are 'very positive trialist reaction' and 'strong acceptance and support' (p31). Earlier the report cites the 'very high rate of endorsement' (p3). On both occasions the questions asked are printed in edited forms, omitting the leading first clause [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20SR%20-%20Summary%20Report%20-%20DNO%20Guide%20to%20Future%20Smart%20Management%20of%20Distribution%20Networks.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20SR%20-%20Summary%20Report%20-%20DNO%20Guide%20to%20Future%20Smart%20Management%20of%20Distribution%20Networks.pdf). The unedited questions are available on p46 of a subsidiary report on consumer attitudes [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A2%20-%20Residential%20consumer%20attitudes%20to%20time%20varying%20pricing.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A2%20-%20Residential%20consumer%20attitudes%20to%20time%20varying%20pricing.pdf)

<sup>67</sup> This was explained at a Low Carbon London learning event on 9 February 2015.

<sup>68</sup> See p30: <http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-%28LCL%29/Project-Documents/LCL%20Learning%20Report%20-%20SR%20-%20Summary%20Report%20-%20DNO%20Guide%20to%20Future%20Smart%20Management%20of%20Distribution%20Networks.pdf>

<sup>69</sup> See page 6: [http://www.element-energy.co.uk/wordpress/wp-content/uploads/2014/07/HEUS\\_Electricity\\_Price\\_Signals\\_and\\_Demand\\_Response\\_Final\\_Report\\_04\\_04\\_14.pdf](http://www.element-energy.co.uk/wordpress/wp-content/uploads/2014/07/HEUS_Electricity_Price_Signals_and_Demand_Response_Final_Report_04_04_14.pdf)

In addition, both CLNR and Low Carbon London found that the measured average peak demand from participants (approximately 1kW) is a lot lower than the figure currently used for network planning (1.5-2kW). Table 6 demonstrates this for Low Carbon London. This information will play an important role in helping DNOs plan network capacity requirements in the future in any given area.

**Table 7: Diversified peak for different Low Carbon London ACORN classifications and occupancy of premises<sup>70</sup>**

	1 person	2 persons	3+ persons
Adversity	0.54kW	0.89kW	1.12kW
Comfortable	0.64kW	0.98kW	1.34kW
Affluent	0.79kW	1.16kW	1.78kW

### Findings

In CLNR and Low Carbon London there have been winners and losers: 95% of consumers benefitted from lower electricity bills in Low Carbon London, 60% in CLNR. However, it is not yet fully understood why the other consumers missed out, which for CLNR is a large minority (40%).

The key findings from our research with regard to the DSR projects are:

- A significant minority of consumers were not able to respond to a time of use tariff, and the findings from these trials provide an opportunity to consider the appropriateness of ToU tariffs for different consumer segments.
- It is not understood what impact the shadow billing / safety net had on the trials. Would consumers have responded differently if they knew their electricity bill could go up? On the other hand, such a measure may help build consumer confidence (and the confidence of consumer advice providers) in tariffs as they are transitioned to business-as-usual.
- Some consumers will not be able to respond to price signals every day, or may have irregular working patterns, which means they can deliver peak time savings some weeks and not others. Certainty is clearly valued in the supply chain, but there is a risk that significant savings could be missed if this, to-date unquantified, market is left unserved. This risk would also imply a disadvantaged segment of the market potentially being left out: it is not known for example if or how the fuel poor will respond to time of use tariffs. The energywise tariff may help identify opportunities to extend offers to this part of the market.
- The CLNR final report states that due to communications failures, 37% of the signals in the direct control trial for smart washing machines were not received. Although the technology is in its infancy, getting this right will be critical to the growth of smart homes. Further review of the CLNR research may also provide insights into how and why participants used the override function.
- Technology also caused problems in the CLNR heat pump and PV trials, another consequence of the innovative nature of these trials. This has meant that some of the data sets are very small (or in some cases abandoned): further work is needed to fully understand the potential in these areas.

## 6.2 Storage and electric vehicles

In the four storage / EV projects - My Electric Avenue, NINES, SoLa Bristol and New Thames Valley Vision - the consumers have a more passive role. Once they are signed up to the project, the smart equipment takes all the decisions for them (ie when to charge the battery, storage heater, hot

<sup>70</sup> See p8: <http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-%28LCL%29/Project-Documents/LCL%20Learning%20Report%20-%20SR%20-%20Summary%20Report%20-%20DNO%20Guide%20to%20Future%20Smart%20Management%20of%20Distribution%20Networks.pdf>

water tank or electric vehicle). As such, there is no override function and so participation is maximised.

### **Safeguards**

Although there is no override function, other safeguards have been put in place to make sure firstly that no participant is worse off than they would otherwise be, and secondly that the services are available when the consumer wants or needs them (eg a charged electric vehicle when you want to drive it).

NINES is unique among the projects studied in this research in that it will become business as usual on Shetland. SSEPD have therefore guaranteed the safeguards will stay in place for as long as the householder stays on the demand side management (DSM) project. This means SSEPD will pay the difference between the old multi-rate and new single rate tariff (currently about 5p/unit). Private householders will also receive £50/year for as long as they stay on the DSM project (social housing tenants received a one-off payment of £100 six months after the storage heaters and hot water tanks were installed). Shadow billing is also in place for NINES but repayments will only be made upon request ('by exception'); however the project team are confident that the new tariffs are so beneficial this will happen only very rarely. The smart technology within the heaters and hot water tanks, working with the DSM systems, make sure there is enough heat available when it is required. The social housing participants were already storage heater users (the new heaters replaced existing older inefficient heaters) but still required help to understand how the new, smart heaters worked (eg digital displays, lifestyle settings) and so were offered post-installation home visits.

SoLa Bristol is also guaranteeing that no householder will be worse off: each household has had new PV panels installed, generating free electricity which will have a significant positive impact on their electricity bills. There is a risk that the storage battery will go flat resulting in the DC lights going off, especially in large families or where there is an Economy 7 tariff as the batteries do not have time to recharge: safeguards have been put in place so the batteries will not discharge any lower than 22V. SoLa Bristol also provided householders with a £50 voucher to buy new lampshades as the DC fittings were bigger than the usual AC fittings. They will also be making a payment to mimic the Feed in Tariff, providing the participants with a double incentive: social tenants would not usually receive the Feed in Tariff where their landlord has invested in and owns the technology.

My Electric Avenue controls when electric vehicles take their charge, to help manage the load on a specific cable at any one substation. Before they got their vehicles, some participants in the trial were concerned that the vehicles would not be fully charged for when they would be needed (eg in the morning to go to work or at 4am for shift workers) and so SSEPD will reimburse any emergency taxi fares should this occur. This has not happened yet, and will be eased by the fact that many of the EVs have been leased as a second car. There should be ample time overnight for all the vehicles on one network to be charged, even when controlled. Emergency contact numbers have also been given out (in line with normal leasing practices) for use if there are any other problems with the vehicles. The EV clusters have been selected on networks where there is plenty of capacity to ensure no risk of interference with the rest of the network. Participants in the accompanying social trial select when their car is charged with no impact by the project, and have the semi-automated option of choosing to have their car charged by a defined time (eg their time of commute, or the end of an off-peak charging period), under which the car determines when to start charging.

New Thames Valley Vision reported that all participants are better off in the trial as they are avoiding the gas cost of heating their hot water.

### **Pre-payment meters**

Although not excluded from the project, no pre-payment meter customers are participating in My Electric Avenue and none have been reported as participants in New Thames Valley Vision. For NINES, SSEPD are taking time to understand PPM usage patterns before those householders are switched to the new flexible charging schedule (about half of the social housing participants). None have been switched over yet but, when they are, further interventions / advice may be required to make sure consumers understand the impact flexible charging could have on their emergency credit (eg the storage heaters may now charge in the day time instead of overnight and, if not expected, this could cause the PPM to run out).

In SoLa Bristol, education has also been needed amongst some participants to explain that the DC lights are independent of the PPM: when the PPM runs out the DC lights will stay on if there is enough power in the battery. This has caused some confusion in at least two cases where the householder did not realise their PPM had run out (because the lights were still on).

### **Public EV charging points<sup>71</sup>**

As well as the dToU trials, another part of the wider Low Carbon London project looked at how, when and where EV users charge their vehicles. Although we have focused on the dToU trials in this Citizens Advice research, the EV findings are still interesting and so are noted in summary below.

The project monitored 1,408 public charging points, 72 domestic and 54 fleet users, and also carried out a questionnaire-based survey with 41 EV users. The project compared the charging behaviour of domestic EV users who were on a ToU tariff encouraging charging after 9pm and those who were not.

The highest demand for residential EV charging was recorded between 6pm and midnight, with very low demand during night and early morning hours. The average charging demand per vehicle is about 3.5 kWh, which corresponds to around 17.5 km in distance travelled (slightly lower than usually assumed although this could be because of the urban nature of London-based journeys). The average duration of residential charging events was 2 hours.

A significant number of the public charging points had zero charging events (ie they were not used). Those that did have charging events were found to be used infrequently (5.5 times per month) with great variations in charging duration and energy. They were used for only small fractions of daily distances travelled, corresponding to about 0.4km. Demand at the weekend was 35% lower than on work days. Through these findings, UK Power Networks has drawn the conclusion that “Whilst public charging infrastructure is often quoted as a barrier or a pre-requisite for the uptake of electric vehicles, it is not yet being heavily used by existing early adopters in the London area.”<sup>72</sup>

### **Findings**

Participants in the storage / EV projects all seem to be benefitting. Benefits in SoLa Bristol and New Thames Valley Vision are both linked to PV (either installed and/or the excess generation is stored in either a battery or via the hot water tank) with householders gaining from reduced energy costs. In NINES participants to date (in social housing) have benefitted from new, free storage heaters and in My Electric Avenue they are taking advantage of low car rental costs.

The key findings from our research with regard to the storage / EV projects are:

- The key observation from the storage / EV projects is that the consumers, once signed up, are passive. The technology makes the decisions for them. Removing the customer interaction increases the likelihood of DNO objectives being met.
- Critical to this though is the presence of safeguards. If the DNO is in control, it is essential that participants have guarantees of service levels or energy costs. These seem to be the projects with most potential to move to business as usual, and so these guarantees will need particular attention if the solution is to remain a commercially viable proposition for the DNO.
- There is still much work to be done to understand how low income, hard-to-reach or vulnerable customers can benefit from these technologies. SoLa Bristol and NINES have worked with very small clusters of social housing tenants and it appears that those consumers who are mainly at home with higher than average heat and power needs could particularly benefit from onsite generation and storage technologies to reduce peaks in demand and reduce their energy bills.

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<sup>71</sup> For further information on the EV trials, see UK Power Networks' reports B1, B2 and B5 at <http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-%28LCL%29/>

<sup>72</sup> See p50: <http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-%28LCL%29/Project-Documents/LCL%20Learning%20Report%20-%20SR%20-%20Summary%20Report%20-%20DNO%20Guide%20to%20Future%20Smart%20Management%20of%20Distribution%20Networks.pdf>

However, the initial investment in the technology required (eg solar panels, smart equipment) could remain a significant barrier.

### 6.3 Energy efficiency projects with no price signal

Less is More and SAVE are the two projects trialling energy efficiency (with no price signal) as a way to reduce demand at peak times and are considered below. Trial one of energywise will also investigate energy efficiency with no price signal in preparation for trial two, where energy efficiency and DSR will be combined. Similarly, one of the four SAVE trials will contain a price signal.

SAVE is still in the recruitment phase, but when it is operational the main instrument that will be used is energy efficiency advice to shift or reduce consumption during peak demand. It will offer LEDs to trial one participants and smart plugs to trials two and three. Critically, trials two and three will also take part in an engagement campaign based on both overall household consumption data and the smart plug data, providing contextual information so householders can see what their information means. Trial four will test a community coaching approach, similar to Less is More.

This means the only operational information we currently have available is from Less is More. No measures have been installed as part of this project but an incentive of up to £5000 is available to each community if it meets targets to reduce or shift their peak electricity consumption. The environmental charities have been running a variety of awareness raising outreach activities including slow-cooker demonstrations and competitions, offering washing lines (to help avoid tumble dryer use), running a '7 minute switch off at 7pm' campaign as well as pop-up advice stalls and door-knocking.

#### Findings

Of the energy efficiency projects, only Less is More is operational. Savings here are not big enough at the local substation level to differentiate from usual 'noise': the magnitude of change needed to recognise a difference outside of normal fluctuations and error allowances would be equivalent to 30% of houses on that network switching everything off. Some households are already frugal with their energy use which makes further savings difficult. Delays in the project start have meant the operational period has been curtailed, limiting the time available to encourage people to change their behaviour.

The key findings from our research with regard to the energy efficiency projects are:

- Each of the environmental charities working on Less is More has developed their own engagement methods for the communities they are working with. This has meant that there is no standard methodology to allow comparisons between different demographics, which could be a lost opportunity. Qualitative research at the end of the project is hoping to reveal which approaches have been most successful.
- Demographic data for Less is More is also limited, other than broad general types to summarise the whole community. This is again a missed opportunity to fully understand who is responding and what is motivating them to do so.
- As is mentioned in section 5.3, Less is More are also working with an entrepreneur to develop an in-home display that provides feedback at a substation level. This responds both to a need for an IHD but also tries to overcome the issue of how consumers identify with their local substation network (see 0 below). A feedback loop such as this is very important.

## 6.4 Community projects

Several of the projects have community aspects as shown in table 7.

**Table 8: Community elements of LCNF projects**

	Community at core of project	Some community element	No community element	Notes
<b>DSR</b>				
CLNR			x	
ECHO			x	
Energywise	✓			Tower Hamlets with outreach workers based in local community centre
Low Carbon London			x	
<b>Storage / Electric Vehicles</b>				
My Electric Avenue		✓		Substation clusters, local cluster champions
New Thames Valley Vision		✓		Bracknell - but scattered
NINES		✓		Shetland - but scattered
SoLa Bristol	✓			Knowle West with outreach workers
<b>Energy efficiency projects with no price signal</b>				
Less is More	✓			10 communities with community support
SAVE	✓			4 communities (2 control) with community champion
<b>Other</b>				
Ashton Hayes	✓			Low carbon village
CLASS			x	
Smart Hooky	✓			Low carbon village

### Identifying a community

In order for the project to work and for results to be identifiable at a DNO level, Less is More clustered communities around substations. However, this has caused problems as people do not necessarily identify with those they share a substation with. This has led the environmental charities treating the project almost as a householder campaign in some areas with individual door-knocking rather than relying on community events.

My Electric Avenue had a similar challenge finding clusters of participants on the same substation and issued maps to local champions to help them find like-minded neighbours. Even in pro-active communities such as Ashton Hayes and Hook Norton, information about the substation networks was new.

SAVE has identified its communities based on a desire to look at the challenges with engaging an affluent geographic community and a deprived geographic community. This has been achieved by referencing Lower layer Super Output Areas (LSOAs) and assessing the level of deprivation within them, combined with known network and resident characteristics. Councils were also asked to nominate communities for the trial and provide additional information to help understand their situation and suitability.

### Working with engaged communities

In Ashton Hayes and Smart Hooky, the DNO responded to and got involved with an existing active community, providing them with additional monitoring data. Both DNOs reported stakeholder

engagement learnings and most importantly the value of being open and honest. The DNOs also learnt that working with a group of volunteers, who usually have other demands on their time, is very different from working in a business-to-business environment.

One of the communities in Less is More also has a very active residents' energy group and are seen as a 'green' community. They have concerns that the energy efficiency measures encouraged by the Less is More team are not far reaching enough.

### **Working with a trusted local partner**

The other four community projects have seen a more pro-active role for DNOs, and in every case they have worked closely with a trusted intermediary to deliver the outreach work: customer field officers recruited by the local community centre in energywise, outreach workers from the Knowle West Media Centre for SoLa Bristol, five local environmental charities in Less is More and paid community champions in SAVE. This delegation shows the DNOs' recognition that this is not their area of expertise. In SoLa Bristol and energywise - the two projects targeting low income households - the community partner is already well known locally and it is likely that participants will have used their other services before (eg activities for children). In Less is More and SAVE, the community workers will have to work hard to create a local presence and to make sure the project is recognised and that people engage.

### **Findings**

Substations are not communities. Neighbours over the road might be on a different network and householders do not always know the people whose house backs on to theirs. Substation 'communities' can also lack a central hub or focal point (eg a school or community centre) which can make communications more difficult and feeds in to a lack of cohesion.

The key findings from our research with regard to the community based projects are:

- People do not identify with substations and feel no loyalty towards or cohesion with them. People are far more engaged with their neighbours on their street or those they share common interests with: the findings from the community champion trials in SAVE will have interesting insights here.
- The DNOs have only been able to make limited contributions to communities that were already active or 'green'. If these approaches were to be rolled out as business as usual, and if these active communities were those where networks were already at capacity, alternative further-reaching measures would have to be introduced for any impact to be seen.
- Feedback loops to participants are again critical. The Less is More website has had mixed use and it would be interesting to find out why people are - or are not - using it. Would they have been more likely to use the portal if it provided information on their own home?
- Incentivising a whole community can also be very difficult: the environmental charities involved in Less is More are struggling to get agreement on what the cash reward should now be spent on. Part of this is because of the dis-connectedness of the substation 'community' and the lack of a hub in many of the areas they are working in.
- For Less is More, the environmental charities are not embedded in the communities: they are not already well known or trusted. In two of the communities however they have worked with other local organisations (Action for Careau and Ely in Cardiff and Alliance Homes in Western Super Mare): qualitative research at the end of the project will assess the difference it made. Working with an embedded, existing local community organisation is the approach adopted by SoLa Bristol and energywise. The response in SoLa Bristol to Knowle West Media Centre has been very good: it will be interesting to see the impact of working with the Bow Community Centre in the energywise project.

## 7 Trials and business as usual

The interviews also asked questions that are very trial specific, such as the impact of being researched, decommissioning and moving to business as usual.

### Impact of being researched

We asked interviewees the extent to which they thought involvement in the trial will have changed consumers' behaviour (compared to the change were these approaches business as usual). Interviewees tended to be of the opinion that the research interventions (as opposed to trial interventions) were infrequent enough not to have an impact on behaviour: there may be a small impact immediately after a survey but this would soon dissipate.

### Decommissioning

We also asked how the trials would be decommissioned and how this has been communicated to the participants. Four of the projects have now finished (Low Carbon London, CLNR, Smart Hooky and Ashton Hayes).

In all the projects, it has been made clear to participants what would happen at the end of the trial, eg that the time of use tariff would end (Low Carbon London, CLNR) or that EVs would have to be returned (My Electric Avenue - although the charging equipment will remain). The most invasive of these will be SoLa Bristol where the lighting systems will have to be reverted to AC, and the batteries removed from the lofts (although the solar panels will remain).

NINES DSM is an exception to the rule, as both the pilot of DSM into social housing homes and the roll out to a further 500 homes is expected to become part of business as usual (BAU) in Shetland. When customers sign up to participate in DSM they do so as part of a rolling annual contract that continues automatically until such a time that a customer or SSEPD provides notice to terminate the agreement. Should a customer decide to terminate the DSM agreement, arrangements will be made to decommission and remove DSM equipment which was installed. Similarly when a customer decides to no longer participate in DSM, SSEPD will look to retain the number of homes participating by signing up another home. To date SSEPD have only seen participants terminating their agreement due to a house move into another house which does not have DSM.

In the absence of an appropriate tariff from suppliers, SSEPD will continue to honour the commitment to pay participants the difference between the single rate tariff compared to the Economy 7 (or similar) tariffs that they would otherwise have been on. They will also continue to pay £50/year to private homeowner for as long as they stay within the DSM project.

### Moving from trials to business as usual

Energy efficiency projects without a price signal were the most risky to DNOs as it was felt that consumers need constant nudges and incentives to sustain their new behaviour, which is expensive and at the moment DNOs are not set up to provide.

The trials that featured a price signal, whether by smart meter, IHD, appliance or SMS are more likely to appeal to DNOs:

*From our trials with domestic customers we consider that time of use tariffs, enabled by smart meters, could deliver value in the next 10 years, when delivered in conjunction with energy suppliers.<sup>73</sup>*

*We will establish time of use tariffs for the distribution element of all customer bills, once half-hourly metering becomes more widespread via the roll out of smart metering, and we will support the development of time of use tariffs by electricity suppliers.<sup>74</sup>*

As discussed above, NINES DSM will continue as part of the wider plan for Shetland. New Thames Valley Vision and My Electric Avenue - both storage projects - were the other projects where DNOs

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<sup>73</sup> See p5: <http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/CLNR-G026-Project-Closedown-Report-2301152.pdf>

<sup>74</sup> Ibid, p18

could most see the potential for BAU at this stage in their development, especially if there is an increased shift to electric vehicles, electric heating and PV. However, the solutions will only be appropriate in certain site specific situations, for example where networks are weak, there are voltage complaints or where network reinforcement would be especially expensive (eg under a motorway or rail line). As has been previously noted, for both these projects the storage mechanisms were in the control of the DNO (within parameters pre-agreed with consumers): once the equipment is active, the consumers had a far more passive role than in the DSR trials. It may be that future technological development is driven more by consumer demand than networks as consumers seek to maximise the benefit of onsite generation and avoid the costs of using imported power, particularly at peak times.

### **Ensuring everyone can benefit**

If projects are to move into BAU, fairness will become an important consideration. DNOs have made sure that none of the participants were worse off through a safety net mechanism, but it might also make DSR more appealing to consumers if a safety net could be maintained in BAU. This raises a question, however, as to whether the business case for domestic DSR could stand up if the extra cost of safety net payments were included. It is worth noting that at £25, the value of the average safety net payment in the CLNR trials<sup>75</sup> was exactly the same as the value of DSR per customer found in the LCL trials, ‘at some substations, before the full costs of implementing such a tariff are taken into account’<sup>76</sup>. However, not too much should be made of this coincidence: the £25 payment would only be made to a minority of customers, whereas the £25 benefit would come from each customer, and the safety net payment would just be another element of ‘the full costs of implementing such a tariff’ noted by Low Carbon London.

In the long term, domestic DSR would only be sustainable (with or without a safety net) if there is sufficient consumer interest (though the safety might help to generate this). Consumers must see what is in it for them or they will not switch, and without enough people switching or adopting new technologies the demand shift will be too small for DNOs to invest.

Engaging directly with consumers is new for DNOs, especially in the community projects where there were strong elements of outreach and support. Hand-holding approaches such as these are expensive and resource intensive and so far the trials have shown little direct benefit to the DNOs in terms of shifting peak demand. However, DNOs interviewed did see the benefit to consumers of these projects, as well as helping meet their own social obligations.

### **Findings**

All the DNOs were clear: in order to be adopted as business as usual, the innovation needs to be cheaper than and as reliable as traditional network reinforcement. Their view is that, once the investment is made, cables in the ground are permanent: they are a known and trusted technology. Any changes to consumer behaviour must be persistent: any uncertainty in this makes it a more risky proposition from a DNO point of view.

The key findings from our research with regard to the trials and moving to business as usual are:

- As the trials come to a close, open and honest communications are once again vital. Participants must understand what is going to happen when, what they will be left with and what they will have to change. All DNOs have included this from the very outset of their interactions with participants but it will need repeating.
- The prospect of smart grids is an exciting one to many people, and many consumers will be able to benefit as has been demonstrated. However, we must be diligent and make sure that sections of society, such as those without internet access or on pre-payment meters, do not get left behind.

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<sup>75</sup> See p44: <http://www.networkrevolution.co.uk/wp-content/uploads/2014/07/CLNR-Progress-Report-7-New-links-.pdf>

<sup>76</sup> See p4: <http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-%28LCL%29/Project-Documents/LCL%20Learning%20Report%20-%20A1%20-%20Residential%20Demand%20Side%20Response%20for%20outage%20management%20and%20as%20an%20alternat-ive%20to%20network%20reinforcement.pdf%29>

- For some of these innovative projects to work as business as usual, DNOs will either have to shift their relationship with their customers and become more visible, or work with other delivery partners such as community advocates or energy suppliers. That also means that there has to be a benefit to all parties for their involvement. Different partnerships have been trialled in these projects but this should be seen as just the beginning.

## 8 Conclusions

This report has explored the consumer impacts of 13 LCNF projects including financial and behavioural outcomes, experience and attitudes, problems experienced and steps taken to mitigate those problems. Demographic data has been used wherever possible, but the detail of data available varies considerably across the projects.

This section brings together our conclusions from across all the projects studied, highlighting good practice, drawing attention to areas of concern and signposting where further investigation may be required.

The projects are extremely varied, using different innovative approaches to meet different aims for different target groups. They are also at different stages in their lifecycle - some are completed, some are mid-trial and others are in the recruitment phase. This makes comparisons difficult in some respects, yet there are still themes that have emerged across all the projects.

The LCNF trials are demonstrating that **correctly implemented smart grid solutions can work for consumers** and, if put into business as usual, should deliver extensive benefits for future consumers. The final results for nine of the projects of course are yet to be seen but from the data available consumers on the demand side response and storage / EV trials are largely benefitting from lower bills. The results are less clear cut for the energy efficiency projects where there is no price signal but even here individual consumers should be able to benefit from reduced consumption if they take up the advice and services provided. The problem with the energy efficiency projects is whether their collective actions are enough to register at a substation level.

However, **not all consumers are benefitting**. 40% of people on the CLNR time of use tariff would have seen increased bills had the safety net not been in place. More work needs to be done to understand why not all consumers responded in a positive way: were they not engaged, were they shifting the wrong things, were they relying on the safety net, did their lifestyles not allow them to shift their load or did they just not understand?

All of the trials had some sort of safety net to make sure participants were not worse off than they would otherwise have been, but this is not expected to be available if the trials moved to business as usual. Further consideration of the impact of the safety net is needed across all the projects: would consumers have acted differently if the safety net were not in place? Is the cost of a safety net a price worth paying for confident consumers and perhaps higher uptake of time of use tariffs than would be the case without such a protection? This will influence any decisions the DNOs may make to move these trials to business as usual.

Some consumers are not benefitting because they have been **excluded from the trials**, usually because technological solutions were not available (eg pre-payment smart meters) or because of other requirements of the trials (eg off road parking, credit checks). However, for smart grid to work for everyone, solutions must be developed for all sections of society, not just the able to pay. The results from energywise and SAVE will add significantly to the body of work in this respect and provide further insight as to how we can innovate for more vulnerable customers.

We must remember too that those who may benefit least from smart may not be the same as our traditional definitions of vulnerable or hard-to-reach consumers. The results from CLNR and Low Carbon London show that at best there's only a weak link between income and the response to time of use tariffs. There is a much stronger correlation in Low Carbon London with size of household, although this has only been shown in terms of absolute energy shift (ie the amount of actual energy householders are using, eg in kWh) rather than relative energy shift (ie the amount of energy as a percentage of the total demand) which is the metric for CLNR. This needs to be better understood as it will feed into the way we consider demographic differences as the smart grid is developed.

**The lack of demographic data, comparable or otherwise**, has been a surprise in this research. The projects that are still operational should be encouraged to collect and report on this data where possible in order to help properly compare and understand the impacts of the trials on different sections of society. Where demographics have been considered, such as CLNR and Low Carbon London, the data has been valued and has impacted the way both DNOs involved in these

projects will plan in the future. **Complaints and consumer satisfaction data** also needs to be more transparent.

Another theme across all the projects is the **value of open and honest communications**. If consumers know what is happening they can take informed decisions and can understand if things sometimes go wrong. Communications also need to be **consistent and ongoing**, particularly if consumers are needed to take action on a regular basis (eg in DSR or energy efficiency projects). At the moment, **DNOs are not set up to communicate with the public** on a regular basis: they do not have strong customer relations because it is not business critical for them as things currently stand. For some of these innovative projects to move in to business as usual, DNOs may choose to shift their relationship with their customers and become more visible, or to work with other delivery partners such as community advocates, energy suppliers, or other third party intermediaries.

All of the DNOs **tailored their messages** to their target audience, and this is critical for projects such as these to succeed. Some DNOs went one step further in terms of consumer engagement and developed and trialled their messaging - everything from the project name and logo to the website and in-home display - with consumer focus groups. Communications also need to be reviewed and refreshed on a regular basis to make sure they are still working.

The **communication methods varied** too, from letters and emails to one-to-one outreach support. Where a communication method did not work the DNOs either tried again or tried something different, which has been a good learning outcome. Consumers increasingly access information by smart phones, but DNOs must not assume that everyone has this technology or internet access. Hard-to-reach consumers, by definition, take more effort to engage with, which takes more time and resource and is therefore more expensive. Nevertheless, it is important that these consumers are not left behind in the smart grid revolution that they help to fund through their energy bills.

These trials by their very nature have been innovative, but this has meant in some cases the **technology** has either not been available or not performed as hoped. Smart communications have also failed in some cases (eg monitoring data in Smart Hooky, or the DSR signal for the smart washing machines in CLNR). On the other hand, however, some technology has moved on even within the lifetime of LCNF (eg substation monitoring equipment) which shows that if there is a demand the market will respond.

The visible technology in people's homes has also been important in these trials and **in-home displays have had a good response**. Participants have responded well to systems with clear, easy to understand messages and graphics, and the feedback received has been on how to simplify systems further (eg incorporate a traffic light system for the dToU tariff in Low Carbon London or make the data also available via a smart phone app).

This also raises the issue of **smart meter data**. There were few concrete findings about willingness to share data and this needs to be understood more, especially with the impending smart meter roll out. Was it because they are early smart meter adopters that trial participants were happy for their data to be used for research, or are consumers less sensitive or less aware of what sharing their data might mean?

Only five of the projects had involvement with **SMEs** and the findings are inconclusive. This is an area that requires further research and development.

Although only four of the projects are finished, the interview responses and our desk research indicates that **there is a place for demand side response, storage / EV and voltage reduction projects as part of a smart grid**. The DNOs have made initial positive comments about the trials moving to business as usual, especially where capacity is already stretched and traditional reinforcement would be particularly expensive. Often this would require working with other partners, who would also have to benefit from the projects. The benefits to DNOs of energy efficiency projects with no price signals are less well proven: the more consumers are relied upon to take action, the more risky the project is in terms of network management.

## Appendix 1: Interviewees for telephone interviews

Project	Interviewees
DSR	
CLNR	Chris Thompson, Northern Powergrid
ECHO	Helen Stimpson & Ellen South, Energy Saving Trust
Energywise	Lynne McDonald, UK Power Networks
Low Carbon London	Adriana Laguna, UK Power Networks
Storage / Electric Vehicles	
My Electric Avenue	Tim Butler, EA Technology
NINES	Maria Liendo & Casey Bauchope, SSEPD
SoLa Bristol	Mark Dale, WPD Sue Mackinnon, Knowle West Media Centre Dr Susanna Martin, University of Bath
New Thames Valley Vision	Mark Stannard, SSEPD
Energy efficiency projects with no price signal	
Less is More	Rachel Coxcoon, Centre for Sustainable Energy Steve Gough, WPD
SAVE	Nigel Bessant, SSEPD
Other	
Ashton Hayes	Geoff Murphy, Scottish Power Energy Network
CLASS	Kate Quigley, Electricity North West
Smart Hooky	<i>(covered in Steve Gough interview - Less is More)</i>

## Appendix 2: Topic guide for telephone interviews

These questions provided the structure for the telephone interviews. Different sections were asked of different projects depending on their focus and what phase they were in (eg recruitment, in trial, complete). Each interview took 30-60 minutes.

### 1. Introduction (ALL PROJECTS)

At the start of the interview explain:

- the aim and purpose of the research
- how the findings will be used
- how we will use your comments (can we quote you directly / would you prefer to be off the record?)
- timescale for publication

### 2. Communications (ALL PROJECTS)

- 2.1 Who were the 'hard-to-reach' customers for your project and how did you engage with them (e.g. those in remote locations; who don't trust the 'electricity board'; English as a second language; debt concerns; lack of internet access)? Did you use different engagement methods for different demographic groups?
- 2.2 Did it matter if consumers didn't know who or what their DNO is? How did you get around this? Have the benefits offset the increased marketing efforts / upskilling within your DNO that has been required?
- 2.3 How important were in-home displays (IHDs) in your project? What did these look like for your project and what feedback did consumers give (e.g. what it did, how it worked, usability, ease of understanding, what happened if it went wrong)? What support did you offer? Could your project have been improved if IHDs have been used?
- 2.4 Were the communication methods you used scalable? For more personalised forms of communication such as face-to-face advice, what were the main benefits? How do these balance with the costs?

### 3. Demand Side Response Projects

- 3.1 What kind of behaviour change did you see?
- 3.2 What information needed to be conveyed to participants - tariff structures, how to use smart appliances, price alerts etc.? How did you manage this? Where used, what have you learned about real time communications? (what worked, what didn't?)
- 3.3 Did some consumers respond better or benefit more than others? Why do you think this is? Was there any demographic skew?
- 3.4 Where available, how often did participants use over-ride functions? What lessons have you learnt from this? Were there any knock-on effects on consumers' broader behaviour or attitudes?

### 4. Storage and EVs Projects

- 4.1 What safeguards were needed (and would be needed in BAU) to ensure the services are available to consumers when they need them (e.g. hot water, fully charged EV)?
- 4.2 What special considerations were given to PPM customers to ensure they are not penalised or disadvantaged, or that their credit doesn't run out when they're not expecting it to?
- 4.3 Did some consumers respond better or benefit more than others? Why do you think this is?

4.4 Where available, how often did participants use over-ride functions? What lessons have you learnt from this? Were there any knock-on effects?

## 5. Energy Efficiency Projects

5.1 How did you try to encourage efficiency? What measures did you use and what did you find effective?

5.2 Based on the experience of the project, what role could DNOs play in energy efficiency? What have you learnt that's new?

## 6. Community Projects

6.1 What were the benefits of working with communities? What problems did you experience and how were these overcome?

6.2 How did working with communities help address equity issues, and reaching the hard-to-reach? Is it cost effective and scalable?

## 7. Monitoring and Evaluation (ALL PROJECTS)

7.1 What have you learnt about who consumers are (customer segmentation)?

7.2 What have you learnt about how consumers respond to incentives and information (customer response)?

7.3 What sort of questions were people asking? What were their concerns? What were the commonest complaints and how were these handled? How did these concerns vary across different demographic groups?

7.4 Did all householders benefit? Does it matter? Should all consumers be at least no worse off in BAU? Did some people 'lose' because of demographics or technical reasons or something else?

9.1 How did you (and will you in BAU) ensure transfer or sharing of benefit to the householder?

## 8. Moving from trial to BAU (ALL PROJECTS)

8.1 To what extent has involvement in a trial changed behaviour itself, especially for those involved in focus groups etc? How has this been tracked?

8.2 How will the trial be decommissioned? How has this been communicated to the participants and how do they feel about it (especially if they've seen a reduction in their energy usage and costs)? Will there be an option for them to carry on (so it becomes BAU) and could they be disadvantaged in any way if they do (e.g. by being on a more expensive tariff)?

8.3 Would the DNO adopt this approach for BAU? What would be the main challenges?

8.4 From your experience of this project, what one piece of advice would you offer, or what are the three lessons you would take for future projects?

## 9. Close (ALL PROJECTS)

At the end of the interview check:

- Are any other thoughts / comments you'd like to add?
- Is there anyone else we should speak to about your project?
- Is it OK if we contact you again if we have any follow up questions?

Thank you for your time!

## Appendix 3: Glossary of abbreviations

AC	Alternating current: the form of electricity that is delivered to homes and businesses
BAU	Business as usual
BMS	Building management system
CLASS	Customer Load Active Systems Services (Electricity North West project)
CLNR	Customer-Led Network Revolution (Northern Powergrid project)
CSE	Centre for Sustainable Energy (project lead for Less is More project)
DC	Direct current; the form of electricity provided by batteries
DECC	Department for Energy and Climate Change
DNO	Distribution Network Operator
DSM	Demand side management
DSR	Demand side reduction
dToU	Dynamic time of use (tariff)
ECHO	Energy Control for House-hold Optimisation (Western Power Distribution project)
EDF	Electricity de France (energy supplier)
ENW	Electricity North West (DNO)
EST	Energy Saving Trust (project lead for ECHO project)
EV	Electric vehicle
GEM	Greenbank Energy Monitor
I&C	Industrial and commercial (class of DNO customer)
IHD	In-home display
kW	Kilowatt: a measure of electricity
kWh	Kilowatt hour: a measure of electricity use
KWMC	Knowle West Media Centre (partner for SoLa Bristol project)
LCL	Low Carbon London (UK Power Networks project)
LCNF	Low Carbon Network Fund
LED	Light emitting diode: a very energy efficient form of lighting
LSOAs	Lower layer Super Output Areas
LV	Low voltage
NEF	National Energy Foundation (stakeholder engagement partner for Smart Hooky)
NINES	Northern Isles New Energy Solutions (SSEPD project)
Ofgem	Office for Gas and Electricity Markets: the gas and electricity regulator
PPM	Pre payment meter
PSR	Priority Services Register
PV	Photo-voltaic
SAVE	Solent Achieving Value from Efficiency (SSEPD project)
SME	Small and medium-sized enterprise
SMS	Short message service: a text message on a mobile phone
SSEPD	Scottish and Southern Energy Power Distribution
ToU	Time of use (tariff)
WPD	Western Power Distribution (DNO)