CELSIUS CUSTOMER SURVEY REPORT

Quantifying the Acceptability of Innovative Retrofit Cooling Techniques

Prepared for Electricity North West

Prepared by Steve Morley

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Project No. 498

Celsius

electricity north west

Bringing energy to your door

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Version history

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Name	Role	Date
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Paul Turner	Innovation Delivery Manager	20 September 2019

Glossary

Abbreviation	Term
CEP	Customer engagement plan
CLASS	Customer Load Active System Services
DNO	Distribution network operator
ECP	Engaged customer panel
FAQ	Frequently asked question
GB	Great Britain
LCT	Low carbon technology
NIC	Network Innovation Competition
Ofgem	Office of Gas and Electricity Markets
Q&A	Question and answer
SDRC	Successful Delivery Reward Criteria
SME	Small or medium enterprise
T3B	Top 3 Box

Foreword

This report is part of the Electricity North West Celsius project (which is referenced hereafter as 'Celsius'), funded via the Office of Gas and Electricity Markets' (Ofgem's) Network Innovation Competition (NIC).

Formal notification of selection for funding for the project was received on 30 November 2015 and the project is due for completion by 31 March 2020.

Celsius explores new ways of monitoring and managing the thermal capacity of assets at distribution substations so that capacity can be maximised and reinforcement costs minimised. The approach can be used by distribution network operators (DNOs) to prepare their networks to meet new requirements arising from the expected increase in the adoption of low carbon technologies (LCTs). It will be the first application of a coordinated approach to managing the temperature of electrical assets in distribution substations across Great Britain (GB).

The project's customer engagement methodology, submitted as part of the Celsius customer engagement plan (CEP), was designed by Electricity North West and its specialist market research provider, Impact, to ascertain whether retrofit cooling techniques have an impact on customers and if the application of these techniques is as acceptable as traditional reinforcement.

The project has identified and demonstrated a range of retrofit cooling techniques that can be used to directly manage the temperature of assets and deliver additional capacity release. In addition to the technical evaluation of these techniques, customer research has been conducted to gather empirical data to establish perceptions on whether the application of the Celsius techniques is acceptable to customers.

This report and the analysis herein forms part of the project dissemination and reference the key findings from three phases of customer engagement.

- The first phase was a piece of strategic qualitative market research carried out with an **engaged customer panel** (ECP). This was designed to test the effectiveness of communication materials in educating customers about the need for Celsius and the benefit of the method.
- The second phase comprised a **baseline survey** which sought to understand customer perceptions about traditional reinforcement and the Celsius proposals to establish a benchmark against which the results of the trial survey (conducted after the interventions had been applied) could be compared.
- The third phase comprised a final **'trial survey'**, conducted with customers living or working in close proximity to substations where cooling interventions had been installed as part of the technical trial. These customers were specifically targeted on the basis that they were most likely to notice audible and/or visual changes to the assets.

The cooling interventions included both active technologies (eg cooling fans) and passive techniques (eg extra ventilation panels and painting transformers with heat-reflective paint). The findings of this survey are also compared to those from the baseline survey

This report fulfils the following two 'customer workstream' Successful Delivery Reward Criteria (SDRCs):

1. Publish customer survey report quantifying the acceptability of innovative retrofit cooling techniques
2. Publish additional customer survey analysis evaluating the change, if any, in the acceptability of innovative retrofit cooling techniques by educating customers.

Electricity North West welcomes this report and recommends it to all stakeholders. This report and related materials have been published on the project website.

1 Executive summary

1.1 Background and objective

DNOs have historically adopted a 'fit and forget' approach to managing electricity networks but the predicted increase in demand resulting from large scale adoption of LCTs, such as electric vehicles and heat pumps, requires a review of the way that assets are managed, to ensure that any costs incurred are efficient. Any increase in electrical load means an increase in current on the network, and the greater the current, the greater the heat generated and the hotter assets become. To ensure that networks are operated safely, all electricity assets are assigned a capacity rating which specifies the maximum amount of energy they can carry. If the substation load exceeds this rating, assets are replaced with new, higher capacity equipment, which is expensive and disruptive to customers. However, these ratings can be conservative and may not take seasonal and environmental factors into account, meaning assets might not be used to their full capacity.

Celsius has explored an innovative approach to managing the temperature of electrical assets inside substations. It seeks to demonstrate that improved temperature monitoring, and also taking action to reduce heat within substations (by retrofitting cooling techniques), can release additional network capacity at a fraction of the cost of traditional reinforcement. Celsius aims to identify how best to intervene to enhance that capacity by using a range of retrofit cooling techniques, and to prove that these techniques are acceptable to customers and can be rolled out across GB.

1.2 Customer engagement hypotheses

The key customer hypothesis of Celsius is that: *"Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement".*

The secondary customer hypothesis is that: *"Customers who are educated as to the need for and benefits of Celsius are significantly more likely to find it acceptable".*

1.3 Research approach

Direct customer engagement took place in three main phases:

1. An **Engaged Customer Panel** (ECP) comprising 10 domestic customers identified what type of materials would be most effective in engaging customers about Celsius in the subsequent phases of research, and which key components of the Celsius method needed to be communicated
2. A **baseline survey** conducted with 600 domestic customers and representatives of organisations classified as small to medium enterprises (SMEs). These customers were recruited in the trial network areas, and were interviewed prior to the installation of the retrofit cooling technique. This approach established a benchmark against which to compare the results of the trial customer survey which would be conducted after Celsius interventions had been applied, in order to measure any change in perception. Before completing the survey, half of the baseline participants were educated about the need for, and benefit of, Celsius compared with traditional reinforcement
3. A **trial survey** conducted with 600 domestic and SME customers on trial networks once the retrofit cooling techniques had been installed and made operational to test the customer research hypotheses. Again, half of the respondents to this survey were educated about Celsius.

Celsius trialed two broad categories of retrofit cooling intervention:

- **Active techniques** –technical solutions involving the trial of cooling fan systems

- **Passive techniques** – simple solutions involving painting substations roofs and externally sited equipment and/or installing shading canopies and additional vents.

1.4 Summary of key findings

1.4.1 Engaged customer panel

The ECP used a deliberative process to test and refine communications materials that would be used in the subsequent, survey phases of the research by answering two questions:

1. Which materials are most effective in engaging customers about Celsius?
2. Which key components of the Celsius method need to be communicated to customers?

This qualitative research found that the most effective materials were:

- **A question and answer (Q&A) briefing document** – clarifying the role of Electricity North West and its position within the electricity sector. This document also explained what substations are, what they do and what they look like
- **Low carbon showcards** – contextualising the anticipated increase in future demand for electricity and the implications of continuing to rely on traditional methods to meet this demand
- **Technique showcards** – describing, through a mixture of narrative and appropriate imagery: a description of possible solutions to meeting future electricity demand (including traditional reinforcement), potential audio-visual effects associated with each technique, and the benefits of implementation to customers
- **A customer leaflet** – summarising the material contained within the Q&A and showcards with further information about the Celsius trial, the rationale for engaging with customers and other frequently asked questions (FAQs).

These materials are published on the Celsius website.

ECP feedback clarified which key components of the Celsius method needed to be communicated to customers. These are summarised in Section 4.1.1 and reported fully in the Customer Focus Group Lessons Learned Report, published on the project website, dated 21 December 2017.

1.4.2 Baseline survey

A pilot study was conducted with 34 customers in January 2018 to test the survey instrument and the methodology before commencing the full baseline survey. The pilot involved face-to-face interviews to simulate the intended baseline approach of a doorstep survey. As a result, the questionnaire was refined by slightly modifying the wording of some questions, to improve clarity and understanding.

For the purpose of this report, where a 1-10 point rating scale has been used, we have reported on Top 3 Box percentages (T3B) i.e. score of 8, 9 or 10 out of 10. This follows our standard reporting practises.

Respondents to the baseline survey were generally very good at identifying substations, although 22% believed that metal telecoms cabinets were substations.

Perceptions on Celsius proposals

Participants who had been educated about the Celsius proposals found them generally acceptable:

- 83% agreed that DNOs need to find new solutions to meet future electricity demand and keep bills low

- 81% agreed that Celsius will help to meet greater demand for electricity by making better use of existing assets
- 70% believed the Celsius proposals were a good solution
- 70% agreed that the benefits of Celsius were clear
- 68% agreed that the proposals were credible.

Perceptions on traditional reinforcement

77% of participants regarded traditional reinforcement acceptable as a technique for meeting increased demand on the network if it were carried out near to their home or place of work.

These baseline findings neither prove nor disprove the research hypothesis that *"Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement*" because the scores for the Celsius proposals relate to the concept and not the *implementation* of the techniques.

The effect of education

Education intervention was not observed to have had any statistically significant effect on perceived acceptability of traditional reinforcement.

Again, this neither proves nor disproves the secondary customer hypothesis is that *"Customers who are educated as to the need for and benefits of Celsius are significantly more likely to find it acceptable,"* because the hypothesis relates to the acceptability of the *implementation* of Celsius.

Awareness of and interaction with Electricity North West

The customers interviewed had little awareness of Electricity North West or its role.

64% said that they were satisfied with the service which Electricity North West provides.

Perceptions on substations

Of the 86% of participants who could identify their nearest substation, more than 90% found its location, general appearance, size and noise levels either 'somewhat acceptable' or 'completely acceptable' on a four-point scale, although the figure for 'completely acceptable' was slightly lower for the three visual aspects if the customer could see the substation from their home or workplace.

Only 8% of baseline participants reported having noticed a noise – most commonly described as a humming sound – emanating from their substation. The majority of these customers (75% in total and all SME customers) described the noise level as "negligible" or "limited".

When customers were asked if they would be likely to notice changes to their substation in the future:

- 86% either 'somewhat agreed' or 'strongly agreed' that they would notice changes if the work caused local disruption and inconvenienced them personally (eg road works or closures)
- 78% believed that they would notice changes if they disliked the new design/structure
- 70% agreed a significant increase in noise would attract their attention
- 68% agreed that they would notice if the location was changed.

The proportion of customers who thought they would notice a difference if a change was made to a nearby substation was higher amongst customers who could see a substation from their home or business premises than those who could not. For example:

- 6% more agreed they would notice changes if the work caused local disruption ie road works

- 9% more would notice changes if they disliked the new design/structure
- 12% more agreed they would notice if the noise volume increased significantly
- 15% more agreed they would notice if its location changed.

Over 90% of respondents believed they would find changes of the types associated with the Celsius techniques acceptable (when asked to designate each change as 'completely unacceptable', 'somewhat unacceptable' or 'acceptable') including:

- Small changes to the structure of the building
- New equipment appearing in the substation's fenced compound
- Changes of colour to externally sited equipment, the building/housing or roof
- Small changes in the level of noise emitted
- Potential glare.

The majority of participants also indicated that they would find disruption brought about by works to make changes to their substation acceptable, although SME customers were less tolerant of this than domestic customers, particularly of road closures lasting for more than a day.

Most participants felt they would notice changes to their substation in the future, particularly those could see their substation from their home or business premises.

The findings of the baseline survey were used as reference points for the results of the trial survey in answering the research hypotheses.

1.4.3 Trial survey

Attitudes to Celsius versus traditional reinforcement

During the administration of the trial survey, participants were shown details about the Celsius retrofit cooling technique which had been installed the substation nearest home/place of work. 89% gave this technique a T3B score for acceptability.

When asked 'How acceptable would you find traditional network reinforcement as a technique for meeting increased demand on the network, if this kind of work was carried out near to your home/place of work?,' 62% of customers gave a T3B score.

These scores are significantly different, proving the hypothesis that *"Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement."*

The score of 62% finding traditional reinforcement acceptable is significantly lower than the results in the baseline survey, where 77% of customers gave a T3B score. Possible reasons for this decrease are:

- All participants (including the uneducated group) in the trial survey were more sensitised to issues relating to substations and reinforcement because they had been notified about after the installation of the cooling techniques at their nearby substation
- The trial survey was conducted a year after the baseline survey and during this time there had been greater media coverage of issues relating to the demand that increasing LCT adoption places on electricity networks
- The availability and understanding of the Celsius solution effectively recalibrated the acceptability of traditional reinforcement by drawing greater attention to its perceived shortcomings
- Variations in the profile of the sample between the two surveys.

Other findings relating to the Celsius interventions were:

- Acceptance was significantly higher amongst respondents who lived/worked near to a substation that had a passive intervention technique installed (93%) than those near to substations fitted with active cooling technologies (85%)
- 76% of respondents (77% near active sites and 75% near passive sites) believed that the intervention technique installed at their nearest substation as part of the Celsius trial should be adopted by Electricity North West
- Just 18% believed that traditional reinforcement should continue to be utilised as the exclusive solution for meeting increased demand.

There were no significant differences in levels of acceptance from participants in different types of area; 94% of customers living/working in rural areas, and 89% of customers living/working in either urban or semi-rural areas, compared with 89% overall. There were also no significant differences across sub-areas of Electricity North West's operating region, with levels of acceptance of Celsius being consistent between 87% and 93% and no discernible differences between levels of support for adopting different techniques.

Other findings relating to traditional reinforcement were:

- Compared with the overall acceptance score of 62% only 48% of customers living/working in Cumbria found traditional reinforcement acceptable but customers from Greater Manchester, Lancashire, and the Merseyside border area all scored between 62% and 67%.

The effect of education

In common with the baseline survey, education had minimal effect in influencing the level of acceptance of the Celsius technique applied at the substation nearest the respondent's home/place of work. Scores were actually lower for educated customers, although not significantly with 89% of all educated customers and 90% of all uneducated customers giving a T3B score.

It can therefore be concluded that the hypothesis *"Customers who are educated on the need for and benefits of Celsius are significantly more likely to find it acceptable",* is not proved.

However, education did make a significant difference to the proportions who found the intervention technique 'completely acceptable' (10 out of 10); 79% of educated respondents compared with only 62% of uneducated respondents, which indicates that education did influence the strength of opinion.

Traditional reinforcement was slightly less acceptable to educated respondents (57%) than to the uneducated sample (64%), although this difference is not statistically significant. The difference was more substantial amongst SME customers where 50% of educated customers and 67% of uneducated customers found traditional reinforcement acceptable. The lower acceptability scores amongst educated customers are thought to be caused by the educational materials sensitising these customers to the detriments of traditional reinforcement.

Observation of and attitudes to changes

- Only 15% of respondents noticed that a change had been made at the substation near to their home/place of work
- Unsurprisingly, the closer a customer lives to a substation, the more likely they are to notice a change: 26% who could see the substation from their home/place of work but only 10% who could not see it noticed a change
- The majority of changes noticed by customers were visual but a small number reported audio changes
- Among participants who had noticed any form of change to their nearest substation, 79% (86% near passive sites and 68% near active sites) found the Celsius intervention acceptable

- Customers in Lancashire were the least accepting of the changes made to their nearby substation, with only 71% giving a T3B score, compared with 80% in Greater Manchester
- Customers were largely satisfied with the changes they noticed to their nearby substation; 33% felt that the changes were an improvement and 55% felt that they made little or no difference. 9% thought changes had caused deterioration.

1.5 Conclusions

1.5.1 Customers are significantly more accepting of Celsius innovative retrofit cooling techniques than traditional reinforcement.

The key customer hypothesis of Celsius is that: *"Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement."*

This hypothesis was proven: 89% of customers reported that the retrofit cooling technique installed at their nearest substation was acceptable, but only 62% found traditional reinforcement acceptable.

1.5.2 Customers who are educated as to the need for and benefits of Celsius are not significantly more likely to find it acceptable

The secondary customer hypothesis is that: *"Customers who are educated as to the need for and benefits of Celsius are significantly more likely to find it acceptable."*

This hypothesis was not proven: showing the educational materials co-created with the ECP during the initial, qualitative phase of the research did not significantly impact acceptability of Celsius. In fact, 89% of these 'educated' customers found it acceptable compared with 90% of 'uneducated' customers. However only 62% of uneducated respondents gave a score of 'completely acceptable' compared to 79% of educated respondents, indicating that education did influence the strength of opinion.

The research findings do not indicate why education had no effect on key performance metrics in this project, but a possible reason is that educating customers can sensitise them to potential negative effects which counter the wider benefits of deploying new techniques. It is also possible that the level of detail provided was insufficient, perhaps because it was not possible to easily convey direct, long-term cost comparisons between traditional reinforcement and the Celsius solutions in a manner that customers felt was directly relevant to them.

1.6 Next steps

In line with NIC governance requirements, there will be ongoing knowledge sharing and dissemination at appropriate industry events and all project information will be published on the Celsius website.

2 Background and objectives

2.1 Project background

2.1.1 The problem

Any increase in electrical load at a substation means an increase in current on the network, and the greater the current, the greater the heat generated and the hotter assets become. To ensure that networks are operated safely, all electricity assets have an assigned capacity rating which indicates the maximum amount of energy each can carry. If the load on a substation exceeds this rating, assets are replaced with new, higher capacity equipment.

With electricity demand predicted to increase as low carbon technologies such as electric vehicles and heat pumps are adopted, the 'fit and forget' approach to managing electricity networks, which distribution network operators (DNOs) have historically used, needs to be challenged to ensure any costs incurred are efficient. Replacing assets is both expensive and disruptive to customers and may not always be necessary as capacity ratings can be conservative and may not take seasonal and environmental factors into account, meaning assets are not used to their full capacity.

2.1.2 Project objectives

Electricity North West's Project Celsius explored an innovative approach to managing the temperature of electrical assets inside electricity substations. It sought to demonstrate that by improving temperature monitoring, and also taking action to reduce heat within substations (by retrofitting cooling techniques), additional network capacity can be released at a fraction of the cost of traditional reinforcement. Celsius set out to identify how to intervene to enhance that capacity by using a range of retrofit cooling techniques, and to prove that these techniques are acceptable to customers and can be rolled out across GB.

2.1.3 Cooling techniques used

Celsius trialed two broad categories of cooling intervention:

1. **Active techniques** –technical solutions involved the trial of cooling fan systems. Two different products were tested, a negative pressure cooling system (supplied by Ekkosense) and a positive pressure cooling system (supplied by Passcomm). Both products were installed across a range of sites and the technical details are reported in the Equipment Specification and Site Installation Report, published on the Celsius website in November 2018.
2. **Passive techniques** – simple solutions involving:

a) Painting substations roofs or externally sited equipment
b) Constructing shading canopies above outdoor substations with externally sited equipment
c) Installation of or the repositioning vents in a substation building
d) A combination of modified ventilation and roof painting.

The showcards which were utilised to describe and illustrate these techniques to the ECP and survey respondents are published on the project webpage. Further detail on the various interventions is provided in the Cooling Equipment Specification and Site Installation Report which is also published on the project webpage, dated 30 November 2018.

2.1.4 Sites identified as appropriate for targeted customer surveys

100 substations in the Electricity North West region were selected for the technical trial of retrofit cooling interventions. Some of these substations were located inside other buildings and/or were not visible to customers.

Whilst the technical aspects of the trial at these sites are extremely valuable to the project, they were not appropriate locations for customer engagement. As a consequence, interviews were conducted with customers residing/working around 62 of the trial sites during the baseline survey and 72 sites during the trial survey, from a total universe of 94 sites where cooling techniques had been applied.

The sites were categorised in two ways:

- **'Active' sites** – where one or more cooling fan system was fitted. It was recognised that customers from properties in close proximity to these might observe an audible or visual effect.
- **'Passive' sites** – modified with reflective paint, shading or additional vents. It was assumed that additional venting arrangements would be less likely to impact customers than visual effects associated with painting sites or erecting shading canopies.

40% of the sites selected to trial Celsius retrofit cooling techniques were active and 60% passive.

2.2 Customer engagement objectives

The Customer workstream sought to understand the impact of the Celsius project on customers by testing two hypotheses:

The key customer hypothesis is that: *"Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement".*

The secondary customer hypothesis is that: *"Customers who are educated as to the need for and benefits of Celsius are significantly more likely to find it acceptable".*

Testing the first hypothesis would allow Electricity North West to understand whether changes to existing assets are noticeable to customers in any way and, if so, how acceptable, in particular within the context of the alternative; traditional reinforcement. This understanding is important to ensure that negative impacts on customers are identified and negated.

Previous innovation research, specifically associated with Customer Load Active System Services (CLASS) and Smart Street, suggests that customers are more accepting and/or supportive of DNOs trialling new technologies that will ultimately benefit them (eg faster connection of LCTs with less disruption and lower costs), when the reasons are explained in *sufficient* detail. However, this effect has never been quantified and Celsius provided an opportunity to measure this effect.

3 Customer engagement methodology

The methodology devised to achieve the customer engagement objectives is set out in full in the Customer Engagement Plan which is published on the Celsius project website.

The customer engagement activities were designed to deliver a comprehensive assessment of any customer impacts associated with the installation of the retrofit cooling techniques at distribution substations. They also aimed to assess how these vary by the technique applied and customer segment.

Direct customer engagement took place in three main phases:

1. An **Engaged Customer Panel** (ECP) which identified what type of materials would be most effective in engaging customers about Celsius in subsequent phases, and which key components of the Celsius method needed to be communicated in these
2. A **baseline survey** conducted prior to the installation of the cooling techniques, to establish a benchmark against which to compare the results of the trial survey
3. A **trial survey** conducted with customers on trial networks once the retrofit cooling techniques had been installed and made operational to test the research hypotheses.

3.1 Engaged Customer Panel

3.1.1 Objectives of the ECP meetings

An ECP was convened to test and refine education information that would be presented as part of a suite of materials during the customer survey phases of the Celsius project to test research hypothesis 2. This phase of the research sought to address two key questions:

- Which materials are most effective in engaging customers about Celsius?
- Which key components of the Celsius method need to be communicated to customers?

The ECP's reactions to a range of proposed retrofit cooling techniques were also gathered.

These research questions were exploratory by nature and required a methodology that elicited deeper understanding of customers' perceptions. Focus groups have proven to be a suitable platform for exploring complex concepts and encouraging informed discussions, and were seen as an appropriate mechanism for this research activity.

3.1.2 Participation of the ECP

The ECP was comprised solely of domestic customers on the basis that they were most likely to be sensitive to changes associated with Celsius cooling techniques near to their property and no technical or commercial insight from business representatives was considered necessary to enhance the learning.

Recruitment was on the basis that participants would attend two scheduled meetings. Participants were geographically clustered to enable easy access to the meeting venues.

A target attendance level of at least eight customers was set for each meeting. Based on previous customer engagement, it was anticipated that the attrition rate of customers who no longer wished to participate would be approximately 10%, or one person, between the two meetings. Recruiting ten customers allowed sufficient mitigation for non-attendance.

The panels included equal quotas of male and female customers. They also reflected a broad customer demographic in terms of age, social grade, region and household composition.

3.1.3 Frequency of meetings and attendance

The ECP met on two occasions in July 2017 in Manchester, 10 panel members attended the first session, and nine the second.

Each meeting lasted approximately 90 minutes and these were facilitated by an accredited Interviewer Quality Control Scheme qualitative moderator.

All research was carried out in accordance with the professional standards set out in the Market Research Society Code of Conduct.

The discussion guides developed to facilitate the group meetings are published on the Celsius website and links to these documents are provided in the Appendix.

3.1.4 Incentives

ECP participants were offered a cash payment of £40 for attending the first meeting and £60 for attending the second. This tiered payment was recommended by Impact based on previous experience of recruiting customers to take part in similar multi-session panels. Panellists were required to sign a claim form to document receipt of the payments, and could elect to donate their incentive to a registered charity of their choice, if they preferred.

3.2 Baseline survey

3.2.1 Objectives of the baseline survey

The baseline survey was conducted in the trial network areas prior to the installation of the retrofit cooling techniques with the objective of establishing a benchmark against which the results of the trial survey (conducted after the interventions had been applied) could be compared, in order to measure any change in perception.

3.2.2 Baseline survey methodology

In recognition that observations of changes associated with a retrofit cooling technique are most likely to impact customers in closest proximity to that asset (immediately adjacent, in front and to the rear of each site), the most appropriate research method was face-to-face interviews. These were conducted at domestic customers' homes or SME premises. All practicable steps were taken to interview customers from a representative sample of properties nearest to substations which had been selected to have a cooling technique applied.

A pilot study was conducted in January 2018 to test the survey instrument (questionnaire) and methodology (face-to-face interviewing) before commencing the full baseline survey.

The pilot involved 34 interviews with customers living near to four trial substations as follows:

- 26 domestic customers and 8 SME customers
- During the interview 19 participants were educated with communication materials about the Celsius project; 15 were not shown any education materials.

Findings from the pilot and resulting modifications are documented in Section 4.2.1.

The main baseline surveys were conducted face-to-face with 600 domestic and SME customers between April and June 2018. Again, interviews took place at and in relation to the participants' homes or places of work. The majority of customers interviewed (548) were domestic. SME customers worked in a range of sectors with the largest proportion of participants in retail.

During administration of the survey, all participants were given information about decarbonisation using 'showcards' (the low carbon challenge showcards are published on the project website - one of these cards gave a brief outline of the Celsius proposals another gave an explanation of what traditional reinforcement entails).

Half of the participants were educated in detail about the need for Celsius, the problem it was seeking to address, and the type of solutions being trialled as an alternative to traditional reinforcement. This was achieved by sharing information about the nature of the industry and the role of Electricity North West. This information was shared prior to the survey via the Q&A leaflet. Additional information was provided during the survey in the project-specific Celsius customer leaflet, which outlined the proposed solutions.

The other half of the respondents in the survey sample were not given any further educational information and were only asked questions relating to traditional reinforcement and existing assets; they were not asked about their attitudes to the Celsius techniques.

All of these materials and the baseline survey instrument are published on the project website with links included in the Appendix.

3.2.3 Cooling sites visited during the baseline survey

The customers surveyed were recruited based on their locality in relation to the substations that would have a retrofit cooling technique installed. Some of the locations included in the technical trial were not appropriate for customer engagement because the substations were inside other buildings and/or were not visible to customers.

Although a majority (60%) of the sites had been selected for a 'passive' technique; there was an aspiration to obtain a larger quota of interviews around proposed 'active' sites, where the potential for audible (in particular) or visual changes was greater. Consequently, the proportions of customers interviewed at active and passive sites were approximately equal.

3.2.4 Participation in the baseline survey

Before commencing the survey, each participant was given the opportunity to read a letter from Electricity North West to reassure them about the authenticity of the research and of the interviewers. This letter also explained the customer's role in the research, clarified that the research adhered to the MRS code of conduct, and gave a designated contact at Electricity North West should the customer have any concerns or further questions.

On average, the length of interview was approximately 20 minutes once the stimulus material had been read.

3.2.5 Baseline survey sample profile

548 participants (91%) were domestic, and 52 (9%) represented SMEs. This is considered to be a statistically robust sample size.

The profile of the sample, in terms of age and gender, was aligned with the population of the North West of England, with slightly more females taking part and a similarly higher percentage of customers aged over 65.

Details of the sample are provided in Figure 3.1 to Figure 3.5 below.

Figure 3.1: Type of environment in which participant lived/worked

Environment	Proportion of sample
Urban	60%
Rural	25%
Semi-rural	15%

Figure 3.2: Domestic participant gender split

Gender	Proportion of sample
Male	45%
Female	55%

Figure 3.3: Domestic participant living situation

Situation	Proportion of sample
Renter	57%
Home owner	40%
Lives with partner or family (doesn't pay rent)	3%

Figure 3.4: Domestic participant age profile

Age group	Proportion of sample
18-25	11%
26-35	14%
36-45	14%
46-55	17%
56-64	15%
65-74	17%
75+	12%

Figure 3.5: SME participant sector

Sector	Proportion of sample
Retail	31%

Sector	Proportion of sample
Health and medical	10%
Leisure and entertainment	8%
Business services (eg accountants, office cleaners)	8%
Manufacturing	8%
Landlord/property developer	8%
Food and drink	8%
Home services (eg plumbers, decorators)	4%
IT	4%
Automotive	2%
Utilities	2%
Creative (eg marketing, advertising, web designer, blogger, writer)	2%

3.2.6 Baseline survey incentives

Participants were given a personal cash incentive of £20 for domestic customers and £30 for SME customers.

3.3 Trial survey

3.3.1 Objectives of the trial survey

The trial survey was conducted once the retrofit cooling techniques had been installed and made operational to measure the acceptability of the Celsius solutions relative to traditional reinforcement techniques.

Analysis of the trial survey allowed the two customer research hypotheses to be tested:

- *"Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement"*
- *"Customers who are educated about the problem that Celsius is seeking to resolve and the benefit of the method, are significantly more likely to find it acceptable."*

3.3.2 Trial survey research methodology

To measure the acceptability of the retrofit cooling techniques, 600 surveys were conducted with customers on trial networks. These took place over a five month period between February and June 2019.

150 surveys were conducted with 'educated' participants who were either:

- Re-engaged educated customers from the baseline survey

- Previously uneducated baseline survey participants who were introduced to education materials in the trial survey
- New participants who were educated for this survey.

The remaining 450 respondents were new to the engagement with no prior education or involvement in the Celsius project.

The survey was administered fact-to-face, on the doorstep. Participants who had previously taken part in the baseline survey and had consented to participate in the trial survey (and provided contact details for this purpose) were contacted in advance by telephone to book interview times. To ensure that survey quotas were met, the interviewers initially approached households and businesses with an educated baseline participant, and then visited other households/businesses in close proximity to the Celsius substation.

During the administration of the survey, all participants were shown the low carbon challenge showcards, one of which gave a brief outline of the Celsius proposals, and the traditional reinforcement showcard. All participants were also shown a showcard illustrating the specific cooling technique installed at their nearby substation.

150 participants were educated in detail about the need for Celsius, the problem it was seeking to address, and the type of solutions being trialled as an alternative to traditional reinforcement. This was achieved by sharing information about the nature of the industry and the role of Electricity North West prior to the survey itself through the Q&A Leaflet. This was supplemented during the administration of the survey with additional information in the project-specific Celsius customer leaflet, which outlined the proposed solutions.

All of these materials and the trial survey instrument are published on the project website with links included in the Appendix.

3.3.3 Cooling sites visited during the trial survey

Customers were interviewed in the vicinity of 72 of the 94 sites where cooling techniques had been applied at that time. The number of sites visited was higher than for the baseline survey (62) for two reasons:

- The technology installation programme overlapped with the baseline survey and consequently some sites that would have been included had cooling techniques applied before the survey was conducted, making them ineligible for the baseline but suitable for the trial survey
- Because of technical challenges some sites, originally selected for retrofit cooling, were found to be unsuitable and discounted. As a consequence, alternative sites were selected to ensure appropriate quotas for the technical trial were met. The timeline meant that these sites were not in scope at the time of the baseline survey, but were eligible for the trial survey.

A small number of sites that had been included in the baseline were not revisited for the trial survey. The project team were alerted to door-to-door scams in one area where baseline surveys were being conducted. Because of heightened sensitivity and concerns about trust and authenticity, interviews around this site were stopped.

The method aimed to attain a proportionally larger quota of trial survey interviews around active sites on the assumption that these customers would be more likely to notice a visual or acoustic change than those near to passive sites, with the exception of impacts associated with paint or shading. It was also anticipated that active interventions were more likely to result in more adverse customer reactions than the passive techniques.

However, as only 40% of the trial sites were categorised as active, it was challenging to interview the same number of customers near active sites as near passive-sites whilst maintaining the required quotas. This was particularly

challenging when it came to re-engaging/newly recruiting educated respondents to robustly test the hypotheses. To rectify this, interviewer shifts were adjusted, allowing them to visit the active sites more frequently than the passive sites. A total of 275 interviews (46% of the total) were achieved around active sites.

3.3.4 Participation in the trial survey

The survey took approximately 18 minutes to complete, once the stimulus material had been read.

3.3.5 Trial survey sample profile

600 interviews were conducted in total, 533 with domestic customers and 67 at SMEs. This is considered to be a statistically robust sample size.

Details of the sample are provided in to Figure 3.10 below.

Figure 3.6: Type of area in which participant lived/worked

Environment	Proportion of sample (trial survey)	Proportion of sample (baseline survey)
Urban	73%	60%
Rural	9%	25%
Semi-rural	18%	15%

Figure 3.7: Domestic participant gender split

Gender	Proportion of sample (trial survey)	Proportion of sample (baseline survey)
Male	44%	45%
Female	56%	55%

Figure 3.8: Domestic participant living situation

Situation	Proportion of sample (trial survey)	Proportion of sample (baseline survey)
Renter	42%	57%
Home owner	56%	40%
Lives with partner or family (doesn't pay rent)	2%	3%

Figure 3.9: Domestic participant age profile

Age group	Proportion of sample (trial survey)	Proportion of sample (baseline survey)
18-25	8%	11%
26-35	17%	14%

Age group	Proportion of sample (trial survey)	Proportion of sample (baseline survey)
36-45	17%	14%
46-55	12%	17%
56-64	16%	15%
65-74	17%	17%
75+	13%	12%

Figure 3.10: SME participant sectors

Sector	Proportion of sample (trial survey)	Proportion of sample (baseline survey)
Home services (eg plumbers, decorators)	26%	4%
Retail	23%	31%
Food and drink	9%	8%
Leisure and entertainment	8%	8%
Health and medical	6%	10%
Manufacturing	5%	8%
Automotive	5%	2%
Business services (eg accountants, office cleaners)	3%	8%
Landlord/property developer	3%	8%
IT	2%	4%
Finance and insurance	2%	-
Travel and transport	2%	-
Creative (eg marketing, advertising, web designer, blogger, writer)	2%	2%
Utilities	-	2%

3.3.6 Trial survey incentives

Both domestic and SME participants were offered an incentive of £25 for completing the trial survey. They could choose a cash payment, an Amazon voucher, or a donation to a charity of their choice. The small increase in the incentive payment (£20 offered to domestic baseline survey participants) was intended to encourage re-engagement of educated customers.

3.4 Required modifications to the planned approach during the course of the project

3.4.1 Recruiting sufficient educated customers for the trial survey

The Customer Engagement Plan had proposed that 150 of the 300 'educated' customers who participated in the baseline survey would be re-engaged to complete the subsequent trial survey. This approach relied on these customers agreeing and being available to take part on a second occasion and the methodology recognised the potential for attrition.

A significant number of the educated participants from the baseline survey were unable, unwilling or ineligible to participate in the trial survey for the following reasons:

- Approximately a year had elapsed since the baseline survey and not all of the participants who had originally indicted they would be willing to participate in the subsequent trial survey were prepared to do so
- Some educated baseline participants had moved and therefore, could no longer be considered part of the educated sample. The new occupants of these addresses were invited to participate
- Some of the educated baseline sample were excluded from participating in the trial after their nearest substation was discounted, as unsuitable for retrofit cooling.

Despite the challenges outlined above, it was possible to re-engage 116 educated baseline respondents, from the pool of 300, leaving a shortfall of 34.

The method included mitigation to cover this situation which involved recruiting and educating previously uneducated customers from the baseline survey.

To achieve the target of 150 educated trial survey participants, to test the hypothesis that *"Customers who are educated about the problem that Celsius is seeking to resolve and the benefit of the method, are significantly more likely to find it acceptable,"* the sample was increased using a two-phased approach:

1. Some of the respondents who had participated in the baseline as part of the uneducated sample were re-contacted and educated about Celsius
2. An entirely new sample of customers, with no prior knowledge of the project, were recruited and educated, enabling them to provide informed responses.

4 Analysis and results

4.1 Engaged customer panel

4.1.1 Which materials are most effective in engaging customers about Celsius?

The primary objective of the communication materials, evaluated by the ECP, was to support/enhance the customer survey in explaining Celsius in an effective and engaging manner. Consultation with an ECP established what the most effective materials in achieving this were and which key components of the Celsius method need to be communicated. This activity also informed the manner in which this information needed to be communicated to facilitate effective engagement and stimulate participation in the quantitative survey.

Lessons learned from this phase of research are briefly summarised below and reported in detail in the Customer Focus Groups Lessons Learned Report which was published on the Celsius website on 21 December 2017. The

discussion guides used to facilitate these meetings and the survey instrument developed from this phase of engagement are also published on the project website.

The ECP found that the most effective materials were:

- **A question and answer (Q&A) briefing document** – clarifying the role of Electricity North West and its position within the electricity sector. This document also explained what substations are, what they do, and what they look like.
- **Low carbon showcards** – contextualising the anticipated increase in future demand for electricity and the implications of continuing to rely on traditional methods to meet this demand.
- **Technique showcards** – describing, through a mixture of narrative and appropriate imagery: a description of possible solutions to meeting future electricity demand, potential audio-visual effects associated with each technique, and the benefits of its implementation to customers.
- **A customer leaflet** – summarising the material contained within the Q&A and information showcards with further information about the Celsius trial, the rationale for engaging with customers and other frequently asked questions (FAQs).

The ECP felt that the key components of the Celsius method that needed to be communicated to customers were:

- Information that would stimulate thought about where the nearest electricity substation is located in relation to the customer's home/place of work, or if it has recently changed in appearance
- Reassurance/confirmation that the Celsius project is not linked to the smart meter rollout
- Narrative explaining that whilst the speed with which electrification of heat and transport is uncertain, notable changes are anticipated over the next decade. This was deemed necessary to contextualise the need for early exploration/investment in alternative solutions to traditional reinforcement
- Visual examples of different types of transformer and housings (to prompt customers to identify the type of substation nearest their property)
- Reassurance that Celsius does not introduce any new safety risks to customers living/working in close proximity to trial substations
- The approximate cost of the base case scenario (traditional reinforcement) versus an estimate of how much less it would cost to implement the alternative
- Any potential audio-visual effects associated with the implementation of Celsius techniques and likely overall benefits of their adoption to customers generally, from the delay or avoidance of reinforcement.

4.1.2 Answering the hypotheses

The educational materials developed during this phase of customer engagement were pivotal in testing research the hypothesis that *"Customers who are educated on the need for and benefits of Celsius are significantly more likely to find it acceptable,"* in the survey phases.

4.2 Baseline survey

4.2.1 Findings from the baseline survey pilot study

The findings of the pilot survey allowed the survey instrument to be refined and the appropriateness of the face-to-face interview method to be confirmed. However, it should be noted that the small sample size meant that the results were not statistically robust.

Lessons learned from the pilot and modifications to the planned approach

Overall, the research instrument and methodology were successful. Response rates were high, respondents were engaged, and insight gathered was valuable. The interviewing team reported, “The survey is absolutely fine and once respondents appreciate you are not trying to sell them electricity, it works well”.

Respondents did not express any concerns with the terminology or information included in the questionnaire, or need further clarification on the topic/areas covered beyond the material provided. The educational information cards intended to support the survey were perceived as helping to build understanding for participants.

The following small adjustments were made in response to customer and interviewer feedback:

Methodology

- To avoid any doubt about the authenticity of the project, the interviewing team were instructed to hand all prospective respondents the warm-up letter from Electricity North West as soon as they introduce themselves, ie before the survey commenced. This was expected both to assist response rates and give added reassurance to customers
- To be identified as appropriate for inclusion in the customer survey, substations had to have domestic and/or SME customers in close proximity. As much information about the location of the nearest substation and their customer type needed to be communicated to the research team to maximise the potential number of suitable respondents from each location
- The incentive of £25 per domestic respondent per completion was felt to be very generous by the interviewing team. Based on their experience in this field, they recommended that this could be reduced and made up of dominations easier to administer. For example, carrying large sums in £5 notes is burdensome and impractical; whereas, it was felt that paying domestic customers £20 and SMEs £30 would work well. The £25 incentive for domestic customers was, however, retained for the baseline survey, as per the commitment made in the original Customer Engagement Plan
- Carrying large quantities of cash when interviewing in the field could have a safety/security implication for the interviewer. Interviewers were therefore only given an amount of cash that they felt comfortable carrying during the full baseline survey
- Showcards had been presented to respondents on a tablet device during the pilot survey; however, some interviewers requested the option of using physical showcards. For the full launch, printed copies were provided to the interviewers. This ensured that respondents had the option of viewing these and/or allowed the interviewer to determine what technique is more appropriate in particular circumstances.

Modifications to the questionnaire

Minor changes were made to the baseline questionnaire in order to improve the overall flow, comprehension and quality of responses. The final, amended version of the baseline questionnaire is published on the project website with a link included in the Appendix.

4.2.2 Attitudes to Celsius versus traditional reinforcement

When survey data is analysed there are choices in how that data is presented which aid presenting the facts in an unbiased manner which facilitate robust conclusions.

Top 3 Box scoring (scores of 8, 9 or 10 out of 10 on a 1-10 rating scale) is the primary approach adopted in this report and is a very common way of reporting and analysing numerical rating scale questions in market research.

Use of top-box measures (eg top two or top three) is a valid stand-alone approach; however, it has been coupled with traditional measures on this project such as evaluating the mean or median.

Theoretically, traditional reinforcement and the Celsius technique could achieve the same average (mean), but may have varying percentages of respondents who have given a top-three box rating. Reporting top three box scores therefore has the advantage of providing more variation in the data.

In the full baseline survey, the educated respondents generally accepted the Celsius proposals[1]. T3B figures for respondents' agreement with various statements about and relating to Celsius are shown in Figure 4.1 below.

Figure 4.1: Customer reactions around Celsius proposals (T3B%)

Statement	All customers (T3B%)	Domestic customers (T3B%)	SME customers (T3B%)
Network operators need to find new solutions to meet future electricity demand and keep bills low	83%	83%	81%
I believe the projections that we will all use more electricity in the future and that electric vehicles and solar panels will become commonplace	74%	73%	84%
Celsius will help to meet greater demand for electricity by making better use of existing substation equipment	81%	80%	90%
I believe what is being proposed is a good solution	70%	69%	84%
The benefits of the project are clear	70%	69%	77%
The solutions proposed are credible	68%	68%	74%

77% of respondents regarded traditional reinforcement acceptable as a technique for meeting increased demand on the network if it were carried out near to their home or place of work. There were no substantial variations in this result across customer segments.

[1] Uneducated respondents could not be surveyed; as the baseline survey was, by design, conducted before the Celsius techniques were installed, the questions in the survey instrument were theoretical in nature and could therefore only be asked of those who had been educated.

These finding neither prove nor disprove the research hypothesis that *"Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement*" because the scores for the Celsius proposals relate to the concept rather than the *implementation* of the Celsius techniques which had not yet been installed.

4.2.3 The effect of education on attitudes towards traditional reinforcement

The education intervention was not observed to have had any effect on the acceptability of traditional reinforcement during the baseline survey.

Again, this neither proves nor disproves the secondary customer hypothesis is that *"Customers who are educated as to the need for and benefits of Celsius are significantly more likely to find it acceptable,"* because the hypothesis relates to the acceptability of the *implementation* of Celsius.

4.2.4 Awareness and interaction with Electricity North West

The customers interviewed during the baseline survey had little awareness of Electricity North West or its role: when prompted, 59% said they had heard of the company, but only 2% would know to contact Electricity North West in the event of a supply interruption. This finding is consistent with previous innovation research.

64% said that they were satisfied with the service which Electricity North West provides.

4.2.5 Perceptions on nearby substations

Customers were generally very good at identifying substations in the baseline survey, although 22% believed that metal telecoms cabinets were substations.

Of the 86% of customers who could identify their nearest substation, more than 90% found its location, general appearance, size and noise levels either 'somewhat acceptable' or 'completely acceptable' on a four-point scale, although the figure for 'completely acceptable' was slightly lower for the three visual aspects if the customer could see the substation from their home or workplace.

Only 8% of customers reported having noticed a noise – most commonly described as a humming sound – emanating from their substation. Of this segment, 75% in total and all SME customers described the noise level as "negligible" or "limited".

4.2.6 Reaction to potential changes at substations: perceived acceptability and satisfaction

Over 90% of respondents to the baseline survey believed they would find changes of the types involved in the Celsius interventions (although these were not framed in this way in the survey instrument) to their substation acceptable (when asked to designate each change as 'completely unacceptable', 'somewhat unacceptable' or 'acceptable') including:

- Small changes to the structure of the building
- New equipment appearing in the substation's fenced compound
- Changes of colour to externally sited equipment, the building/housing or roof
- Small changes in the level of noise emitted
- Potential glare.

The majority of customers also indicated that they would find disruption brought about by works to make changes to their substation acceptable, although SMEs were less tolerant of this than domestic customers, particularly of road closures lasting for more than a day:

- 95% of domestic customers but only 77% of SME customers said they would accept disrupted parking for a day
- 82% of domestic customers said they would accept a road closure for more than a day, but only 49% of SME customers said they would accept this.

When customers were asked about whether they felt they would notice changes to their substation in the future:

- 86% agreed that they would notice changes if the work caused local disruption and inconvenience to them (eg road works or closures)
- 78% reported they were likely to notice changes if they disliked the new design/structure
- 68% agreed that they would notice if the location of street furniture was changed
- 70% agreed a significant increase in noise would attract their attention.

The proportions of customers who thought they would notice a difference if a change was made to a nearby substation was higher amongst customers who could see their substation from their home or business premises than those who could not. For example:

- 6% more agreed they would notice changes if the work caused local disruption such as road works
- 9% more would notice changes if they disliked the new design/structure
- 12% more agreed they would notice if the noise volume increased significantly
- 15% more agreed they would notice if its location changed.

4.2.7 Answering the hypotheses

The findings of the baseline survey were used as reference points for the results of the trial survey in answering the research hypotheses.

4.3 Trial survey

4.3.1 Attitudes to Celsius versus traditional reinforcement

89% of all trial survey respondents (94% of customers living/working in rural areas, and 89% of customers living/working in either urban or semi-rural areas) gave the Celsius intervention technique that has been used near their home/place of work a T3B score for acceptability.

Customers who lived/worked near to a substation that had a passive intervention technique installed gave a significantly higher T3B score than those near to substations fitted with active cooling technologies, as shown in Figure 4.2 below.

Figure 4.2: Acceptability of Celsius techniques

Intervention technique	Top 3 box %
Active intervention technique (Net)	**85%**
- Cooling fan (positive pressure) Passcomm	86%
- Cooling fan (negative pressure) Ekkosense	84%
- Cooling fans (both systems)	100%
Passive intervention technique (Net)	**93%**
- Vents and painted roof	93%

Intervention technique	Top 3 box %
- Paint	95%
- Shading	92%
- Vents	92%

Figure 4.3: Acceptability of Celsius techniques

When asked 'How acceptable would you find traditional network reinforcement as a technique for meeting increased demand on the network, if this kind of work was carried out near to your home/place of work?,' 62% of respondents gave a T3B score.

This is significantly lower than the proportion of customers who gave the Celsius intervention technique that had been used near their home/place of work a T3B score (89%), proving the hypothesis that *"Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement."*

The 62% who reported traditional reinforcement acceptable is significantly lower than the results in the baseline survey, where 77% of customers gave a T3B score. One potential reason for this decrease is that all participants in the trial survey were more sensitised to issues relating to substations and reinforcement because they had received a Customer Information Card which notified them of the installation of a cooling techniques at their nearby substation, even if they were part of the uneducated group. The original intention was that the uneducated sample would not receive any information to alert them to a change at their nearest substation; however, mitigation was required when an overarching Electricity North West policy was introduced, prior to the trial survey phase, which placed a requirement on staff to distribute an advisory leaflet to any customers likely to be disturbed by on site works. This information card may have increased sensitivity in the trial survey sample. Their sensitivity may also have been increased because the trial survey was conducted a year after the baseline survey, and during this period issues relating to the impact of increasing levels of LCT adoption on electricity networks had received greater media attention.

Another possible reason for the decrease is variations in the profile of the sample between the two surveys: there were more urban and fewer rural participants in the trial survey, more home owners and fewer renters, and more home services SME participants and fewer retailers. However, as T3B scores were similar across these dimensions in baseline survey, it seems unlikely that these variations would account for the lower acceptance of traditional reinforcement in the trial survey.

76% of customers believed that the intervention technique installed at their nearest substation as part of the Celsius trial should be adopted by Electricity North West. This was slightly higher (77%) from respondents near to an active intervention site and slightly lower for those near to passive sites (75%). Only 18% believed that traditional reinforcement should continue to be utilised as the exclusive solution for meeting increased demand, while the final 6% believed a different Celsius intervention technique should be adopted than that deployed at the substation nearest to them.

4.3.2 The effect of education

Level of education had minimal effect in the trial survey on T3B acceptance of the Celsius technique carried out near their home/place of work, and in some cases scores were actually lower for educated customers, although not significantly. However, education did make a significant difference to the proportions who found the intervention technique 'completely acceptable' (10 out of 10). Scores are shown in Figure 4.3 below.

Figure 4.4: The effect of education on acceptance of Celsius

Customer group	Educated (T3B%)	Uneducated (T3B%)	Educated ('completely acceptable')	Uneducated ('completely acceptable']
All customers	89%	90%	79%	62%
SME customers	86%	90%	68%	68%
All customers who had noticed a difference at their nearby substation	81%	85%	73%	52%

It can therefore be concluded that the hypothesis *"Customers who are educated on the need for and benefits of Celsius are significantly more likely to find it acceptable",* is not proved although education did influence the strength of opinion.

Traditional reinforcement was slightly less acceptable to educated respondents (57%) than to the uneducated sample (64%), although this difference is not statistically significant. The difference was more substantial amongst SME customers where 50% of educated customers and 67% of uneducated customers found traditional reinforcement acceptable. The lower acceptability scores amongst educated customers are thought to be caused by the educational materials sensitising these customers to the detriments of traditional reinforcement.

4.3.3 Differences between customer segments

There were no statistically significant differences in acceptance of Celsius between customer segments across sub-areas of Electricity North West's operating region in the trial survey, with levels of acceptance being consistent between 87% and 93%.

There were also no discernible differences in the support for the adoption of the different techniques, as shown in Figure 4.4 below (note that the 0% score for 'cooling fans both' was from a small base of customers).

Figure 4.5: Support for adoption of Celsius measure/s used at nearby substation during trial

Intervention technique	% Support
Active intervention technique (Net)	**77%**
- Cooling fan (positive pressure) Passcomm	80%
- Cooling fan (negative pressure) Ekkosense	77%
- Cooling fans (both systems installed at site)	Low base
Passive intervention technique (Net)	**75%**
- Vents and painted roof	79%
- Paint	74%
- Shading	80%
- Vents	73%

37% of rural customers believed Electricity North West should continue to use traditional reinforcement as the primary solution to meet increased demand. This is consistent with rural customers' greater acceptance of traditional reinforcement (69%) compared with all customers (62%).

Only 78% of students, used as a proxy for future customers' perceptions, scored the Celsius intervention technique installed at their nearby substation as acceptable (compared with 89% of all customers); however, this was a small sample of only 18 in total and is therefore not statistically robust to draw conclusions from.

Educated customers were also asked to give their reactions to a range of statements relating to the network and to the Celsius solutions to add context and further understanding of how acceptable the trial/concept is as a whole is to them. Figure 4.5 below shows these participants responses along with responses from the baseline survey.

Figure 4.6: Customer reactions to Celsius (T3B%)

Statement	Trial survey (T3B%)	Baseline survey (T3B%)
Network operators need to find new solutions to meet future electricity demand and keep bills low	91%	83%
I believe the projections that we will all use more electricity in the future and that electric vehicles and solar panels will become commonplace	83%	74%
Celsius will help to meet greater demand for electricity by making better use of existing substation equipment	75%	81%
I believe what is being proposed is a good solution	73%	70%
The benefits of the project are clear	79%	70%
The solutions proposed are credible	67%	68%

The only score which was significantly different in the trial survey was for the statement 'The benefits of the project (Celsius) are clear'. The reasons for this higher level of agreement is unclear; however, the majority of educated trial survey respondents had taken part in the baseline and were therefore already aware of Celsius, and previous innovation research has demonstrated the value of re-engagement in increasing levels of awareness. Another factor may be that respondents had a greater understanding of the Celsius technique as an intervention had been made at their nearby substation.

Traditional reinforcement was acceptable to 69% of customers living in rural areas, to 65% of customers in urban areas, and to 52% of those living/working in semi-rural areas. Analysis also revealed regional variations across Electricity North West's operating area: Only 48% of customers living/working in Cumbria found it acceptable, while the score for customers in Derbyshire was even lower (13%); however, the Derbyshire sample was very small (eight customers) and therefore not considered statistically robust. There were no further regional differences; customers from Greater Manchester, Lancashire, and the Merseyside border area all scored between 62% and 67%.

Traditional reinforcement was slightly less acceptable to educated customers (57%) than to uneducated customers (64%), although this difference was not statistically significant. The difference was more substantial amongst SME customers where 50% of educated customers and 67% of uneducated customers found traditional reinforcement acceptable. The lower acceptability scores amongst educated customers are thought to be caused by the

educational materials sensitising these individuals to the existence and benefits of alternatives to traditional reinforcement.

4.3.4 Substation changes noticed

Overall, only 15% of participants in the trial survey noticed that a change had been to the substation nearby to their home/place of work.

Substation proximity

The proportion of customers who noticed a change increased to 26% amongst those who could see their nearby substation from their home/place of work but reduced to 10% amongst customers who could not see it. The nearer a customer lives/works to the substation, the more likely they are to notice a change, as shown in Figure 4.6.

Figure 4.7: Distance from nearby substation of customers who noticed a Celsius change

Distance from nearby substation	% noticed a change:
1-20 metres	35%
20-50 metres	24%
50-100 metres	23%
100+ metres	13%

Changes type and site type

The majority of changes noticed by customers were visual changes, but there were nine reports of audio changes. Figure 4.7 shows the full breakdown of changes noticed by intervention type. More changes were noticed around passive sites (the bottom four rows) than active. However the changes reported at active sites were more disruptive.

Figure 4.8: How Celsius interventions were noticed

Intervention type	Completed interviews	Customers who noticed changes No.	Customers who noticed changes %	Change noticed (count)			
				Noise	Colour	Structure	Other
Cooling fan (positive pressure) Passcomm	114	18	16%	4	6	2	7
Cooling fan (negative pressure) Ekkosense	157	16	10%	3	2	2	9
Cooling fans (both systems)	4	0	0%	0	0	0	0
Vents and painted roof	63	18	29%	2	7	3	7
Paint	71	7	10%	0	6	0	1
Shading	30	4	13%	0	3	0	2
Vents	161	28	17%	0	0	8	20
Total	**600**	**91***	**16%**	**9**	**24**	**15**	**46**

*customers could tick multiple changes

Noise changes

Duration of change: Of the nine customers who reported a change in noise levels during the trial survey, two reported that the noise was only temporary, and had now stopped by the time of the interview – one mentioned that it had lasted a few days, and the other a few weeks.

When the change was first noticed: Four customers said that they had noticed the changes in the previous three months, two said they were between three and six months ago, and three said they had first observed them between six months and a year ago.

Three of the nine customers reported that the noise was not something that's new, as they had always heard a noise from the substation.

Extent of change: One customer described the original noise as 'moderate', another as 'limited', and the third as 'negligible'.

Nature of change: Respondents said the sound was like 'humming', 'static' and 'low pitched/drone'. The new noise heard by customers was described by six as 'significant'; of the remaining three, one reported it to be 'moderate' and the final two as 'negligible'. Three customers described the sound of the noise as 'low pitched/drone' and 'whirring', two said it was 'humming', and one described it as 'banging'.

Four of the customers reported the noise as continuous, running through the day and night. Two customers reported the noise as sporadic but said they heard it most days, and the final customer reported it would "come and go" and 'heard occasionally through the night'.

The changes in noise levels were mostly described as having increased. Figure 4.82 shows customers' free text responses when asked to describe the change in noise levels.

Figure 4.9: Customer descriptions of Celsius-related changes in noise levels

Active intervention sites	Passive intervention sites
"There is like a new light that is inside it but you can see it from my house." *Cooling fan (positive pressure system) Passcomm* "A deep droning vibration noise, its constant 24 hours. More noticeable through the night. I can hear it in all rooms upstairs, and especially if I wake during night. It's like white noise, very stressful. We've recently had secondary glazing, but this penetrates it." *Cooling fan (positive pressure system) Passcomm* "They have increased, the new fan is noisy." *Cooling fan (negative pressure system) Ekkosense*	"Completely different. There was no noise before." *Vents and painted roof* "They have increased considerably and they are constant plus there's vibrations." *Vents and painted roof*

It should be noted when considering the observation of change associated with the passive sites that whilst new venting arrangements could, in theory increase the potential for pre-existing noise levels, emanating from equipment within a substation, to be heard; investigations suggest that these reports were very unlikely to be

associated with Celsius. However, the reports of noise from active sites were confirmed to be associated with the fan setting and appropriate remedial action was taken by the Electricity North West in response to these reports.

Visual changes

The majority (82 out of 91) of customers who noticed a change noticed a visual change.

Duration of change: 22% of customers who noticed a visual change explained that the change was only temporary and had since returned to its original appearance, but 78% reported that it still looked different.

When the change was first noticed: 18% of customers reported that they had first noticed the changes within the last three months, more than half (56%) said that they had noticed them between three and six months ago, and 26% thought they had first seen them between six months and a year ago.

Type of change: Installations involving vents were the most noticed. A full breakdown of the visual changes noticed, split by intervention technique, is shown in Figure 4.9 including the open-ended responses specifying 'A small change to the structure of the substation' or 'Other'.

Figure 4.10: Visual changes noticed

Intervention	Change noticed	Number who noticed this change	Free text responses
Cooling fan (positive pressure system) Passcomm	The substation/equipment has been painted white*	2	
	New equipment has been put in/around the substation	4	
	Reflective materials installed on or around the substation*	2	
	Other (please specify)	6	"I thought they were building houses there" "Basis tidying up, no major works" "Been painted" "Workmen there" "Just tidied it up generally" "They have cleaned it up"
Cooling fan (negative pressure system) Ekkosense	New equipment has been put in/around the substation	3	
	A small change to the structure of the substation e.g. a new door/vent or a change in the position of a door/vents (please specify)	4	"they have removed the old brown door and replaced it with an open see through metal gate also chopped some of the shrubbery down" "a new gate, the old door has been removed" "vents and been cleaned up" "new vent on the front"
	Reflective materials installed on or around the substation	2	

Intervention	Change noticed	Number who noticed this change	Free text responses
	Other (please specify)	6	"A bigger fan was installed" "They have caught the trees down and tidied up a bit" "the stone work has been painted" "They have done away with the door and put a see through gate on it" "The substation was burnt down so it has been rebuilt" "only noticed vans parked outside nothing else"
Vents and painted roof	The substation/equipment has been painted white	5	
	A small change to the structure of the substation e.g. a new door/vent or a change in the position of a door/vents (please specify)	5	"New vents on the side" "Vents and brickwork looks different and cleaned up around" "New vents added" "New vents" "Vents been added"
	The substation has changed size	1	
	Other (please specify)	5	"Colour" "Turbos going round" "Cleaned up around it" "Looks like they've changed the brickwork looks cleaner" "There's a path been built up to it"
Paint	The substation/equipment has been painted white	5	
Shading	New equipment has been put in/around the substation	1	
	Other (specify)	3	"Painted green and white" "Been painted green and white" "Painted green shelter over it"
Vents	A canopy has been installed over the substation*	1	
	New equipment has been put in/around the substation	2	
	A small change to the structure of the substation eg a new door/vent or a change in the position of a door/vents (please specify)	13	"Vent" x2, "Vents" x4, "New vent" x2 "New doors" "A frame on the back being fitted and vents being fitted" "Inside work" "Doors" "Vents for a fan"

Intervention	Change noticed	Number who noticed this change	Free text responses
	The substation has changed in size	1	
	Other (please specify)	11	"A tidy up around the substation" "Just a tidy up around it" "Inside work" "Phone network" "Fence" "New fencing I think" "Internal work" "They put a stone pebbles in front" "The ground around it tidied up" "Updating everything" "Ground[s] outside have improved"

*It should be noted that some of the above observations are difficult to explain because they do not correlate with the physical changes at substations where specific retrofit cooling techniques were installed. For example two respondents near to substations retrofitted with a positive pressure fan system reported that equipment had been painted white, which was not the case. Two respondents noticed new reflective materials, which may be associated with the external casing of the fan system.

Likewise one of the respondent living near to a traditionally constructed substation, where the venting arrangement had been slightly modified reported having observed the installation of a canopy, which was not the case.

Regional differences

20% of customers in the Greater Manchester area noticed a change, which was significantly more than in the other parts of the Electricity North West region. This effect is likely to be explained by the Greater Manchester area having the highest number of substations that had invention type 'vents and painted roof' carried out, which was proportionally the most-noticed change, as shown in Figure 4.7.

Only one customer in each of Merseyside (out of 20) and Derbyshire (out of 8) noticed a change, while 11% noticed a change in each of Lancashire (out of 150) and Cumbria (out of 70).

4.3.5 Acceptability of changes noticed

Of the customers who noticed a change in the trial survey, 79% gave a T3B score, indicating that they are accepting of the work that has been done. There were differences between customers living/working near active and passive substation sites: only 68% of customers near an active site gave a T3B score compared with 86% of customers near a passive site. Figure 4.10 shows the T3B scores across intervention types. There were no changes noticed by customers interviewed around 'cooling fan both' sites.

Figure 4.11: Acceptability of changes noticed by intervention type

Intervention technique	% T3B
Active intervention technique (Net)	**68%**
- Cooling fan (positive pressure) Passcomm	72%
- Cooling fan (negative pressure) Ekkosense	63%

Intervention technique	% T3B
- Cooling fans (both systems)	Low base
Passive intervention technique (Net)	**86%**
- Vents and painted roof	83%
- Paint	86%
- Shading	100%
- Vents	86%

Customers in Lancashire were the least accepting of the changes made, with only 71% giving a T3B score, compared with 80% in Greater Manchester. 88% of customers in Cumbria were accepting of the changes, but the base size of eight was low, and both of the single customers from each of Merseyside and Derbyshire who noticed the change were accepting.

Overall, customers were largely satisfied with the changes they noticed to their nearby substation; 33% felt that the changes were an improvement and 55% felt that they made little or no difference. 9% thought they were a deterioration and 3% weren't sure.

Slightly more customers around active sites (12%) compared with passive sites (7%) felt that the changes were a deterioration, although the highest proportion who felt there was a deterioration lived or worked near passive sites with the addition of vents and a painted roof (22%). Over half of customers (57%) with a substation nearby that had been painted, felt that the differences made shown an improvement. Figure 4.11 shows the full distribution of scores (figures for 'Don't know' are not shown.); it should be noted that these figures are not robust due to the very small sample sizes, although they are expected to be indicative of perceptions.

Figure 4.12: Impact of changes noticed by intervention type

Impact	Cooling fan (positive pressure) Passcomm n=18	Cooling fan (negative pressure) Ekkosense n=16	Vents and painted roof n=18	Paint n=7	Shading n=4	Vents n=28
An improvement	22%	25%	28%	57%	0%	46%
Make little or no difference	61%	56%	50%	29%	100%	54%
A deterioration	11%	13%	22%	0%	0%	0%

The majority of customers who noticed the change (86%) had not or did not plan to take any action in relation to it. A further 2% took action immediately, 5% took action but not straight away, and 7% had yet to take to take action at the time of the interview but planned to do so. Of the 13 customers who had taken or planned to, five contacted or planned to contact Electricity North West, one planned to contact their energy supplier, and seven stated 'Other', with comments relating to calling the police, approaching the council, or not knowing exactly who to contact. The Celsius project team were informed of these responses, where the respondent had agreed for their details to be shared with Electricity North West and appropriate action was taken to address concerns arising from the

installation of cooling techniques. These cases are highlighted in Section 4.4 and reported in the Project Progress Reports, published on the Celsius website.

4.3.6 Answering the hypotheses

The key hypothesis of the customer workstream was:

"Customers within the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement"

This hypothesis is supported by the results of the trial survey as 89% of customers gave the Celsius intervention technique that has been used near their home/place of work to meet increased demand on the network a T3B score for acceptability. This is significantly higher than the score of 62% given for traditional reinforcement. This establishes the suitability of the Celsius techniques for rolling out across GB.

The secondary hypothesis tested by this research was:

"Customers who are educated on the need for and benefits of Celsius are significantly more likely to find it acceptable"

This is not supported by the results of the trial survey which found that the level of education provided did not significantly impact the overall acceptability of the intervention technique carried out near a customer's home/place of work, with 89% of all educated customers and 90% of all uneducated customers

Education only had a significant impact in the proportions of customers who found the intervention technique as 'completely acceptable' (10 out of 10); 79% of educated customers (and 73% of those who noticed a change at their substation) compared with 62% of uneducated customers (52% who noticed a change) chose this option.

4.4 Customer contacts

In addition to the survey, the project team implemented a strategy to ensure that all customer enquires or complaints associated with any aspect of Celsius were captured and managed appropriately. Any concerns, reports of change or disturbance identified during the survey were reported to the project manager (where the customer had provided explicit consent that their details could be shared). These cases are summarised below. Full details can be found in the Celsius monthly project progress reports (PPRs) on the project website.

Figure 4.13: Celsius customer enquiries

Nature of enquiry	Number of enquiries	Resolution
As a result of participation in the baseline survey, the customer was concerned about the *potential* for audible disturbance or aesthetic impact associated with an (as then) undefined cooling technique	1	
Noise from an Ekkosense system	1	

Nature of enquiry	Number of enquiries	Resolution
Noise or other disturbance associated with Passcomm sites	6	Resolutions involved the adjusting of fan settings and set points (timing and activation temperature) and, on some occasions, the relocation of the fan to inside the substation, although this reduced the cooling effect. A learning for wider roll out is that this solution may not be practical for all environments. In one case the trial unit was switched off as it contributed to pre-existing noise from the transformer; the learning was that more comprehensive acoustic surveys should be undertaken prior to installing active techniques at substations in close proximity to domestic properties.
Concern about the authenticity of the trial survey	2	The project team explained the genuine nature of the research and the customer were suitably reassured.

5 Lessons learned

This section of the report disseminates the learning outcomes from each phase of the customer research activity. The learning is focused on describing how DNOs and their stakeholders can capitalise on this process by identifying and responding to challenges that may arise in future customer engagement activities of a similar nature.

5.1 Engaged customer panel

This report focuses specifically on the results from analysis of the Celsius survey. Lessons learned from the ECP are reported in the Customer Focus Lessons Learned Groups report, published on the project website on 21 December 2017.

5.2 Baseline survey

Lessons learned during the pilot phase of the baseline survey are detailed in Section 4.2.1 in conjunction with resulting adjustments to the research methodology.

There was one lesson learned from the main baseline survey:

- Customers struggle to accept the concept of planned supply interruptions (even of a short duration) to upgrade electricity networks, unless they fully understand the benefits of works necessitating the interruption.

5.3 Trial survey

5.3.1 Re-engaging respondents can be challenging

To test the second customer workstream hypothesis that '*Those who are educated about the problem that Celsius is seeking to resolve and the benefit of the method, are significantly more likely to find it acceptable',* the approach was to re-interview 150 of the 300 'educated' customers who took part in the baseline survey. This rationale was

expected to provide a sufficient sample of pre-educated customers for the analysis. However, the process of re-engaging and re-interviewing the 300 educated respondents from the baseline survey proved challenging.

It was anticipated that there would be a level of attrition between the baseline and test survey and therefore, mitigation was factored into the method. In the event, despite a slightly higher incentive payment (for domestic respondents, £20 was offered for participation in the baseline, increasing to £25 in the trial survey), a significant number were unable, unwilling or ineligible to participate in the second survey and it was not possible to re-engage the optimal number of the original sample for the following reasons:

- Approximately one year had elapsed since the baseline survey which led to some participants from the baseline no longer being willing to participate in the trial
- Some of the original participants had moved, therefore the home was no longer part of the educated sample
- Some of the educated respondents had to be excluded from the re-contact list because the technical trials had not gone ahead at their nearest substation.

It was only possible to re-engage 116 customers from the pool of 300, leaving a shortfall of 34. As outlined above, the project plan provided appropriate mitigation and the strategy to ensure that as many interviews as possible were conducted by the original survey population.

In order to achieve the target of 150 educated test surveys to test the hypothesis, the sample was increased using a two-phased approach. Firstly, some of the respondents, who participated in the baseline as part of the uneducated sample, were re-contacted and educated about Celsius; secondly, an entirely new sample of customers, with no prior knowledge of the project, were recruited and educated, enabling them to provide informed responses.

Future projects, which require repeated engagement, should consider the approach adopted in Electricity North West's Second Tier LCN project, CLASS, which had a much lower rate of attrition. This was likely to have been influenced by higher incentivisation, which similarly was weighted with increasingly higher value payments offered as the research progressed. In CLASS, this was combined with an effective communication strategy, which was maintained throughout the trial period, via regular newsletters and website updates. For less complex research methods, where an extended period of engagement is likely to result in attrition, a less intensive communication approach could be considered which simply involves periodic project updates to set expectations about when follow up engagement activities/surveys will take place, acting as a reminder, before re-contact is established.

5.3.2 An imbalance in the number of active and passive sites led to fewer customer responses for active sites than planned

To assess customer perceptions of the impact of the Celsius techniques, it was necessary to recruit customers residing or working in the immediate vicinity of the intervention sites. To comply with GDPR and negate issues concerning data sharing, these surveys were conducted face-to face, on the doorstep.

Fieldwork researchers, conducted the baseline and test interviews using a 'cold-calling' approach, which enabled them to specifically target properties in close to the substations where cooling techniques had been applied.

The research methodology aimed to prioritise interviews around active sites, on the basis that customers are far more likely to notice a visual or acoustic change at these sites than small modification made at the passive sites. It was also anticipated that active interventions would be more likely to result in adverse customer reactions than the passive techniques.

However, as only 40% of the substations were modified to active retrofit techniques, it was challenging to interview as many customers near to active sites as passive-sites, whilst maintaining the required demographic quotas to robustly test the hypothesis.

To remediate this, interviewer shifts were adjusted, allowing them to visit the active sites more frequently than the passive sites, whilst also targeting educated respondents. This led to responses being obtained from a higher proportion of residents near active sites. A total of 275 interviews (46% of the total) were achieved around active sites.

5.3.3 Cash is more popular than Amazon vouchers as an incentive

Interviewers observed that respondents were less likely to agree to participate in the survey when they were offered an Amazon e-voucher instead of cash. Interviewers believe this is partly due to some participants not being digitally engaged.

The research methodology was therefore adjusted during the research period so that cash was offered as an incentive which enabled a more diverse sample of customers to be engaged. Interviewers were only given the cash on a daily basis to ensure they were never in possession of too much to reduce the financial impact of any theft from their person.

Whist this was a successful strategy, it is recognised that offering cash payments for participation in face to face, doorstep research can place the interviewers in potentially vulnerable circumstances. This strategy is ill-advised in certain areas, particularly were interviewers are likely to in the vicinity for a reasonable period of time and 'word is likely to get around'. To mitigate this, interviewers attended in pairs as an additional safeguarding measure.

5.3.4 It is important to represent customers in close proximity to interventions

As outlined in Section 3.3, fieldworkers conducted face to face interviews on the doorstep to target respondents living or working at properties in the immediate vicinity of substations where Celsius cooling techniques had been applied.

During the survey, a small number of respondents, who had noticed a change and were unhappy about the situation, asked for their details to be passed to Electricity North West. These details were shared (with the explicit consent of the respondent) with designated members of the Celsius project team, who had a process in place for dealing with such enquiries.

Fieldworkers were supplied with photos of each site and an aerial view map, which identified properties bordering and close to the respective sites. The aim was to interview occupants of properties immediately adjacent, in front and to the rear of each site. This was not possible in all cases because target customers were sometimes unavailable or unwilling to participate. Because of the challenges of engaging agreeable and suitable participants, fieldworkers were allowed limited discretion to slightly extend the range of the survey to properties that did not immediately border the site. Whist this strategy was largely successful, the investigation of one enquiry about increased noise levels, revealed that the complainant lived close, but not next to a passive intervention technique (vents and a painted roof) and therefore, the reported increase in noise was unrelated to Celsius. This was verified by on-site acoustic investigations conducted by the delivery team. This situation underlined the importance of interviewing households/businesses located as close to the substation as possible to ensure that participants were commenting on Celsius-related changes only. This situation resulted in a reiteration of the criterion to interviewers who then more stringently adhered to recruiting customers from properties bordering the respective sites.

5.3.5 Do not contact households displaying 'No cold callers' signs

Electricity North West received a query regarding the legitimacy of the survey from a relative of an elderly customer who had been approached to participate in the survey, with the suggestion that personal data had been requested in exchange for a financial incentive. This case highlighted complications associated with approaching potentially elderly and vulnerable customers on their doorsteps, where no signage exists to indicate that the occupant does not wish to, or is not able to make an informed decision about taking part in market research. As a result of this case, the complainant arranged for a 'No cold callers' sign to be displayed at the elderly relative's home.

This case was amicably resolved by Electricity North West and the complainant was reassured with the information provided about the nature of the research and the professional standards followed by the interviewers.

The lesson learned was that whilst market research is exempt from cold calling due to the legitimate interest of participating in the survey, best practice dictates that the existence of such signage suggests the household would not be open to participating in market research interviews, which have not been booked in advance. As a result of this case, interviewers were instructed not to approach any households with such a sign on display and this approach should be adopted in similar research of this nature.

6 Conclusion

The customer engagement methodology utilised in the Celsius project was designed to answers to two hypotheses.

The key hypothesis was: *"Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement"*

The secondary hypothesis was: "Customers who are educated as to the need for and benefits of Celsius are significantly more likely to find it acceptable"

The approach drew on learning and experience from previous customer engagement in similar projects. The inclusion of an initial, qualitative phase of iterative research with an ECP enabled an effective pilot study prior to the launch of the full baseline survey. This in turn ensured that the survey instrument and supporting educational materials were robust and effective. Similarly, conducting a baseline survey before the technical trials, followed by customer survey during the trials, gave a reference for the final results.

The key hypothesis was proven: in the trial survey, 89% of all respondents found the retrofit cooling technique installed at their nearest substation acceptable, but only 62% found traditional reinforcement acceptable, showing that customers are significantly more accepting of Celsius innovative retrofit cooling techniques than traditional reinforcement.

A key finding associated with this research was that a surprisingly low proportion of customers (15%) noticed a change to their nearby substation during the technical trials.

The secondary hypothesis was disproven: the level of education given did not significantly impact acceptability of Celsius. In fact, 89% of 'educated' customers found Celsius acceptable compared with 90% of 'uneducated' customers. However only 62% of uneducated respondents gave a score of 'completely acceptable' compared to 79% of educated respondents, indicating the education did influence the strength of opinion.

Previous innovation research, suggests that customers are generally more accepting and supportive of DNOs trialling new technologies or techniques that will ultimately benefit them (eg faster connection of LCTs with less disruption and lower costs), when the reasons are explained in sufficient detail.

The Celsius research findings do not indicate why education had no effect in this project, but a possible reason is that educating customers can sensitise them to potential negative effects which counter the wider benefits of deploying new techniques. It is also possible that the level of detail provided was insufficient, perhaps because it was not possible to easily convey direct, long-term cost comparisons between traditional reinforcement and the Celsius solutions in a manner that customers felt was directly relevant to them.

7 Next steps

This report fulfils the following two customer workstream SDRCs:

- Publish customer survey report quantifying the acceptability of innovative retrofit cooling techniques
- Publish additional customer survey analysis evaluating the change, if any, in the acceptability of innovative retrofit cooling techniques by educating customers.

In line with NIC governance requirements, these findings will be shared during ongoing knowledge sharing and dissemination at appropriate industry events and all project information referenced in this document will be published on the project website.

8 Appendix

The following materials were used to support the three phases of customer engagement and are published on the Celsius website:

Figure 8.1: Links to Celsius materials published on the project website

Item (with link to document on website)	ECP	Baseline survey	Trial survey
A question and answer (Q&A) briefing document	✓	Educated only	Educated only
Customer focus group 1 discussion guide	✓		
Customer focus group 2 discussion guide and showcards	✓		
Baseline survey instrument		✓	
Trial survey instrument			✓
Low carbon challenge showcards	Draft versions included in Customer focus group 2 discussion guide	✓	✓
Technique showcards	Draft versions included in Customer focus group 2 discussion guide	Traditional reinforcement showcard only	Traditional reinforcement and nearest intervention showcards
Customer information leaflet	✓	Educated only	Educated during survey Uneducated after survey
Customer information card			✓