ofgem

RIIO NIC NETWORK INNOVATION COMPETITION

Project Code/Version Number:

1: Project Summary

1.1: Project Title	**Power Saver Plus (PS+)**		
1.2: Project Explanation (50 words plus diagram / image)	An innovative approach which uses targeted energy efficiency as an alternative to network reinforcement. It will deliver a whole system benefits evaluation tool for DNOs to identify the most effective mix of efficiency interventions, smart and traditional solutions. It will reduce network costs, lower customer bills and reduce CO_2 emissions.		
1.3: Funding licensee	**Electricity North West Limited**		
1.4: Project description: (300 words)	*The Problem:* The energy sector is in a period of unprecedented change, with market participants exploring new and more efficient means to meet the changing needs of customers and the challenging carbon targets laid down by Government. With the increasing adoption of low carbon technologies such as electric vehicles and heat pumps, the landscape of customer demand and generation is changing significantly. It is recognised that energy efficiency has a significant role to play in meeting these challenges but the current delivery approach in the UK is expensive for customers and is failing to help prepare for the low carbon future. *The Method:* By trialling a number of targeted energy efficiency interventions with a representative sample of homes and small businesses in our region, PS+ will trial the hypothesis that a DNO can deploy targeted, cost-effective energy efficiency as part of its load management strategy to deliver benefits for the network and for customers. *The Solution:* PS+ will deliver an alternative approach to meeting the energy efficiency challenge by taking a whole system approach to managing network costs, losses, carbon and energy consumption under a single initiative. The project will deliver the tools needed for DNOs to determine the costs and benefits of efficiency measures for the first time and compare them to other available techniques. *The Benefits:* Targeted efficiency interventions can avoid reinforcement and bring significant additional benefits for customers. Energy efficiency delivers benefits across the entire energy supply chain, creates or releases network capacity, reduces costs, reduces CO_2 and improves the economic well being of customers, particularly the fuel poor.		
1.5: Funding			
1.5.1: NIC Funding Request (£k)	£7 020	1.5.2: Network Licensee Compulsory Contribution (£k)	£790
1.5.3: Network Licensee Extra Contribution (£k)		1.5.4: External Funding – excluding from NICs (£k):	£286
1.5.5: Total Project Costs (£k)	£8 187		

1.6: List of Project Partners, External Funders and Project Supporters (and value of contribution)	Project Partners: BRE Consulting Group, The Energy Saving Trust, Delta Energy and Environment, University of Salford, Impact Research and NERA Economic Consulting Project Supporters: Scottish & Southern Electricity Networks, Greater Manchester Combined Authority, Institute for Public Policy Research North		
1.7: Timescale			
1.7.1: Project Start Date	January 2018	*1.7.2: Project End Date*	June 2022
1.8: Project Manager Contact Details			
1.8.1: Contact Name & Job Title	Cara Blockley, Central Services Manager	*1.8.2: Email & Telephone Number*	cara.blockley@enwl.co.uk 07771 352655
1.8.3: Contact Address	Hartington Road, Preston PR1 8AF		
1.9: Cross Sector Projects (only complete this section if your project is a Cross Sector Project, ie involves both the Gas and Electricity NICs).			
1.9.1: Funding requested the from the [Gas/Electricity] NIC (£k, please state which other competition)	N/A		
1.9.2: Please confirm whether or not this [Gas/Electricity] NIC Project could proceed in the absence of funding being awarded for the other Project.	N/A		
1.10: Technology Readiness Level (TRL)			
1.10.1: TRL at Project Start Date	6	*1.10.2: TRL at Project End Date*	8

Section 2: Project Description

2.1: Aims and objectives

The Problem

The energy sector is in a period of unprecedented change, with all market participants exploring new and more efficient means to meet the changing needs of customers. Innovation and whole system thinking are key to helping ensure the GB electricity system meets those needs and continues to deliver the challenging carbon targets laid down by government. At the same time we need to question the traditional roles and boundaries of participants in the energy sector to ensure customers receive the best possible outcomes in the future.

With the increasing adoption of a range of new low carbon technologies (LCTs) such as electric vehicles (EV), heat pumps (HP) and photovoltaics (PV) the landscape of customer demand and generation is changing significantly. The energy sector, electricity in particular, has been identified as a priority area in which significant carbon savings can be achieved.

As part of the Paris agreement, adopted in December 2015, each participating country submitted an Intended Nationally Determined Contribution, which is a pledge on how that country would achieve the global goal. Research carried out by the Committee for Climate Change (CCC) suggests the power sector will be a key contributor, with some scenarios suggesting the sector could reach net zero carbon by 2050. GB DNOs and the electricity network as a whole need to act to meet this significant challenge.

Impact of LCTs on electricity networks

In low numbers, LCTs can be accommodated on the existing network; but early adopters of LCTs tend to occur in clusters, with schemes or incentives for LCT-uptake focused on small areas or groups of customers. Future load scenarios suggest that new LCTs will continue to occur in clusters. This clustering has a dramatic effect, with peak loading on localised areas of the low voltage (LV) network increasing sharply, introducing a requirement for reactive reinforcement, often before an asset has reached the end of its useful life.

Current approach to energy efficiency

It is recognised that energy efficiency has a significant role to play in meeting the challenges of a low carbon future. Domestic buildings are responsible for approximately 23% of total UK carbon emissions[1] and it has been identified that 65% of British homes would benefit from energy efficiency improvements. Therefore in recent years there has been a focus on carbon reduction in the domestic sector.

While most European countries place their obligation for delivering energy efficiency on network operators, in GB the responsibility lies with energy suppliers. The deployment of domestic energy efficiency interventions at scale has been delivered by suppliers under the Energy Company Obligation (ECO) scheme since 2013[2].

Suppliers typically deliver their ECO obligation using a combination of in-house resources and contract energy efficiency installers. They recover the cost of their obligation directly

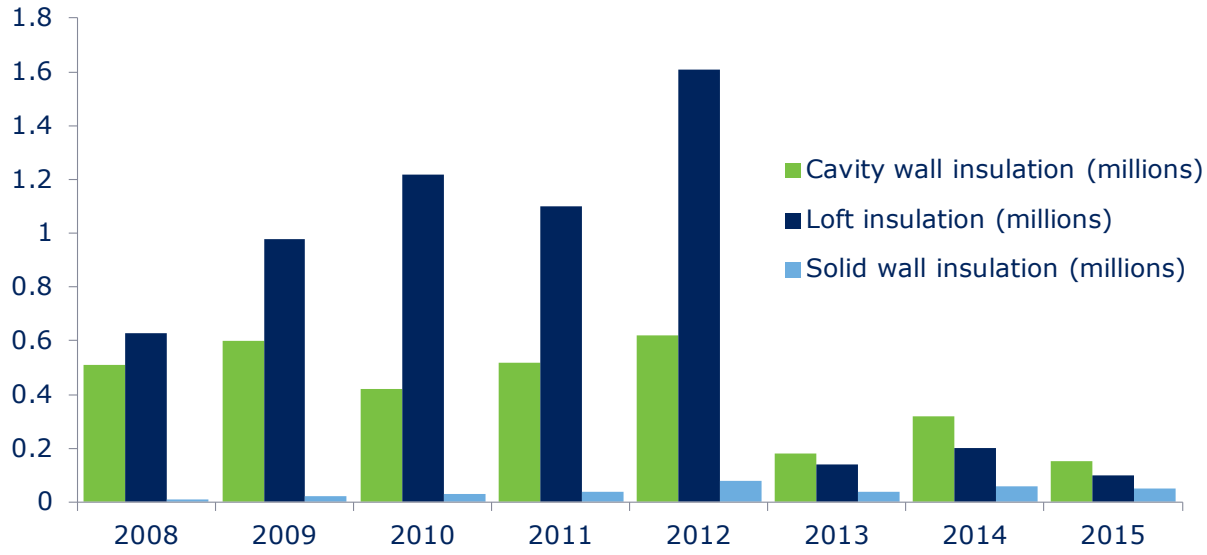
[1] www.gov.uk/government/uploads/system/uploads/attachment_data/ file/511698/20160331_1990-2014_UK_GHG_final_end_user_emissions_and_ uncertainties.pdf

[2] This scheme addresses Article 7 of the Energy Efficiency Directive (EED), which states that energy distributors and/or retail energy sales companies operating in each Member State must achieve a cumulative end-use energy savings target by 31 December 2020. To meet their obligation, Suppliers who fall under the ECO obligation in the UK must identify private domestic premises occupied by people in receipt of specific benefits, whose occupants are referred to ECO through a local authority declaration, or social housing with an Energy Performance Certificate (EPC) energy efficiency rating of E, F or G. The eligible measures under ECO are currently wall insulation, gas boilers and electric storage heating and a handful of other measures.

through customer bills over a very short period. Costs are applied uniformly across all of the suppliers' customer base and can represent a significant proportion of the bill.

In recent years energy efficiency deployment into the UK domestic building stock has stalled due to decreased funding, completion of early heat-based easy wins and customer uncertainty surrounding standards of delivery. Figure 2.1, published by the CCC, illustrates how the deployment of wall and loft insulation has fallen dramatically from 2008 - 2015.

Figure 2.1: Deployment of insulation in the UK



In short, the current approach to energy efficiency in GB is failing customers and failing to help us meet the challenges of the low carbon future.

The Method

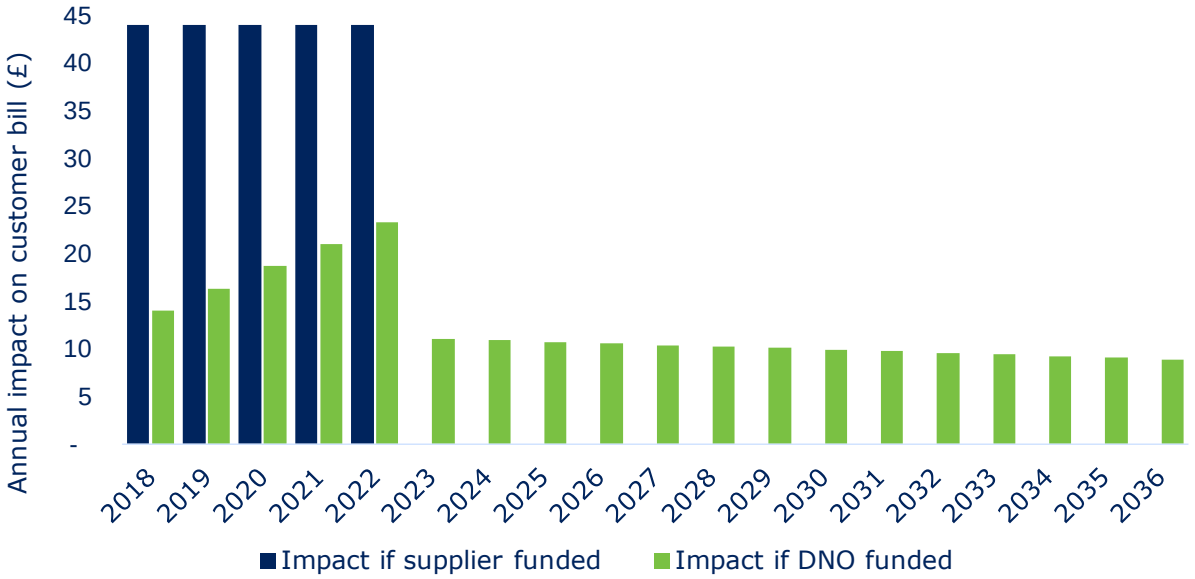
PS+ will address the energy efficiency challenge by taking a whole system approach to managing network costs, losses, carbon and energy consumption under a single initiative. The project will trial the hypothesis that a DNO can deploy cost-effective energy efficiency interventions either on its network and/or at the customer side of the meter to deliver 'stacked' benefits for the network and for customers. The project will trial a number of interventions with a representative sample of homes and small businesses in our region.

Cost benefits of network operator-led energy efficiency

In contrast to the short time frame during which suppliers need to recover ECO costs from customers, if energy efficiency was funded by DNOs, the profile of cost recovery would be much longer. A minority of the costs would be recovered within a short period as 'fast money', and the remaining 'slow money' would be added to the replacement asset value and recovered over up to 45 years. This is more aligned with the timeframe of energy efficiency benefits realisation.

We believe this approach, coupled with DNOs having no conflict of interest on energy efficiency interventions, would deliver a number of significant benefits for customers. Figure 2.2 shows an indicative view of how the cost of ECO delivery impacts on a customer bill, compared to the cost recovery timescales for a DNO to deliver the ECO scheme.

Figure 2.2: Cost impact of energy efficiency on customer bills



Network and customer benefits of DNO-led energy efficiency

A DNO would take a whole system view when making decisions on the location and targeting of energy efficiency. With appropriate targeting the benefits can be stacked to deliver greater value for customers overall. For example, areas of the network which are approaching capacity limits, circuits which suffer high network losses and/or areas where there are fuel poor customers would offer greater benefits than other areas.

From a network perspective, natural improvements in the efficiency of domestic appliances will progressively reduce the load imposed on the electricity network over time. However, this decrease in load will not occur fast enough to offset the projected upturn in demand from LCTs.

By pro-actively enabling customers to reduce their demand, we can achieve a significant reduction in load, associated reinforcement costs, network losses and carbon emissions. The combined effect will deliver a wide range of benefits including lower customer energy and network bills. These in turn bring additional societal and economic benefits to customers.

Figure 2.3: The proposed steps for the Method

Proposed steps	Description
Overview of network	We will take a whole system view of our network to determine where, when, how and why future constraints will occur.
Overlay datasets	We will overlay multiple additional datasets on our network data including housing types, social demographics, occupancy and fuel poverty areas, to establish an informed view of where we could intervene with energy efficiency interventions for the benefit of our network and customers.
Identify trial areas	The use of multiple datasets will give us a complete picture of where network constraints occur and will allow us to determine where the deployment of an intervention will achieve multiple benefits. Our primary focus will be network benefit, but additional benefits can be used as a multiplier to build a whole system case for deployment in particular areas.

Proposed steps	Description
Recruitment	We will use multiple channels to engage with and recruit customers in these areas. We will trial the recruitment methods to determine which is most effective. We will conduct an in-depth energy survey to establish energy usage, attitudes and energy-consuming devices in customers' premises. From the data collected we will segment the trial areas and propose a range of energy efficiency interventions to trial.
Deployment	We will deploy a range of energy efficiency interventions at customers' premises. This deployment will be informed by the information collected during the survey process to deliver the optimum network and customer benefit on the area of the network on which it is deployed.

To further mitigate network constraints we will explore the deployment of PV installations on a free issue or significantly subsidised basis on municipal buildings to deliver reduced network demand, reduced losses and reduced carbon. We will also explore the feasibility of deploying PV on some substations to reduce losses. We will carry out feasibility studies to identify sites where PV can be used to deliver benefits, (predominantly addressing summer peak demands) and where the installation does not cause any detrimental effects to the local network.

The development or demonstration

PS+ will take a new approach to managing network constraints and the efficient management of networks by including energy efficiency interventions in DNO strategies. The project will prove the efficiency of using a whole system view of benefits for network customers. It will measure the network and customer benefits of energy efficiency and develop a set of tools to enable a DNO to consider the deployment of energy efficiency interventions as an alternative to traditional methods of network reinforcement.

PS+ will demonstrate that energy efficiency interventions can:

- Help alleviate fuel poverty for Electricity North West's customers, improving economic and social outcomes within our region
- Decrease losses, enabling the more efficient running of the network and thereby decreasing costs for all of our customers
- Create capacity headroom to enable the connection of more LCTs to our network and hence reduce network reinforcement costs
- Deliver more value from installed assets, avoiding the cost and planned outages associated with asset reinforcement
- Reduce costs for customers by reducing network losses.

The Solution

By reducing load on our network, we can reduce the overall costs of accommodating LCTs as well as reducing losses, deferring asset reinforcement and reducing energy costs for our customers. The cumulative savings of this Method are applicable, and will be available, to all customers across GB. Our business case indicates this saving, scaled up to GB level, would be around £350 million by 2050. The modelling suggests that this approach, if combined with measures deployed under ECO and applied at scale, also has the potential to move a proportion of Electricity North West customers out of fuel poverty.

The learning from this and forerunner projects will deliver a 'buy order' tool (Power Saver Tool) to enable a DNO to determine where, when and which measures to deploy within its network region to deliver the optimum benefit to the network and its customers. The learning will also deliver an updated whole system cost benefit analysis (CBA) model based on the current Ofgem CBA model. In addition we will trial and deliver the

techniques needed to allow DNOs to effectively engage with customers and deploy energy efficiency interventions where justified.

Moving forward into business as usual, DNOs will be able to add energy efficiency deployment into their network planning procedures. They will be able to take a targeted whole system approach, deliver an efficient and robust network, contribute towards the UK's carbon targets and deliver wider societal benefits. PS+ will make use of all relevant available sources of data including housing stock, social demographic, Energy Performance Certificate (EPC) data and network mapping data. In this way the costs associated with creation of the Power Saver Tool will be kept to a minimum.

The PS+ trial will deliver:

- New knowledge to determine when it is appropriate, acceptable and delivers best value to customers for a DNO to deploy energy efficiency interventions
- A Power Saver Tool which will enable a DNO to determine where, when and which measures to deploy within its network region to deliver the optimum benefit to the network and its customers
- An upgraded Ofgem CBA model for RIIO-ED2 that will enable DNOs to submit, and Ofgem to evaluate, proposed energy efficiency interventions.

2.2: Technical description of project

PS+ will take a whole system approach to managing network constraints by trialling alternative approaches to network reinforcement, specifically the deployment of targeted energy efficiency interventions. The project will measure the network and customer benefits of energy efficiency and develop a set of tools to enable the deployment of such interventions as an alternative to traditional methods of network reinforcement.

Energy efficiency deployment

We have conducted a gap analysis of a wide range of forerunner projects, to identify where our proposed scope fits within the work that has already been undertaken. A summary of our findings can be found in Appendix D. We have identified that the SEPD SAVE and UKPN Energywise projects sit closest to PS+ in the UK, although the target customer base for the projects was specific to certain customer types. We have engaged with the relevant project delivery teams to discuss the scope of our trial and capture any learning that has been gathered so far.

PS+ will take this learning forward to deliver an alternative approach to delivering energy efficiency. The project's whole system approach means energy efficiency will be better targeted and more cost effective. The innovative Power Saver Tool and upgraded CBA model will allow DNOs to determine the costs and benefits of efficiency measures for the first time and compare them to other available techniques.

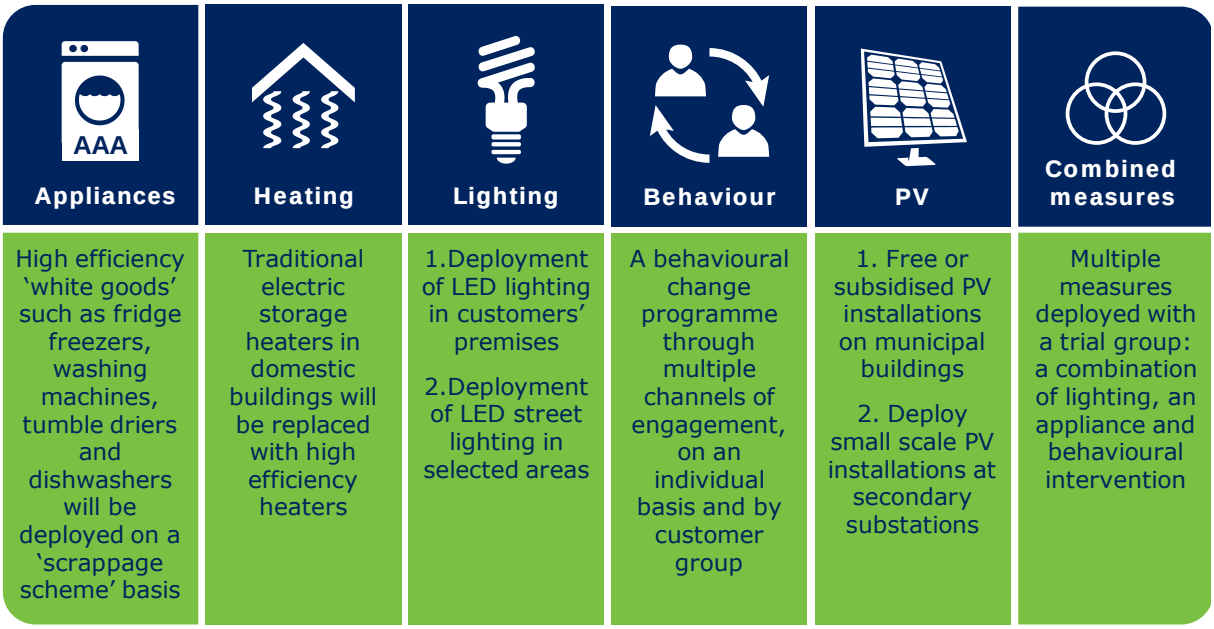
The project will trial a range of energy efficient technologies and behavioural interventions (see Appendix E) to reduce energy demand across a representative sample of our customers to deliver the optimum network benefit as an alternative to traditional and smart network reinforcement. We will consider and evaluate all appropriate electrical efficiency interventions based on a range of factors including potential network benefit at scale, and customer acceptability. This approach will allow project suppliers and partners to deliver alternative methods to mitigate and defer network reinforcement and enable faster, cheaper connection of low carbon technologies to the network.

Following the site selection process, PS+ will identify the most appropriate energy efficiency interventions to deploy on each area of the network. These will be chosen to give the optimum balance between customer acceptability, cost and achievable demand reduction. The technological interventions described in Figure 2.3 have been selected so that they require no disruptive installation work within the customer's premises and can be deployed quickly and easily avoiding any interruption to the customer's supply. We

will explain to customers the benefits they will receive from the trial, clearly explaining why the intervention has been chosen and how the trial could benefit them and the network. All interventions in the customer's home will be subject to their consent.

In the majority of trials we anticipate deploying a single type of energy efficiency intervention on a given circuit, selected using the results of the survey. These will be monitored before, during and after the trial, to ensure the data collected provides a mechanism to robustly quantify the benefit of each energy efficiency intervention in isolation under controlled but realistic conditions. These will be deployed to enable comparison of different networks, interventions, demographics, customer types and housing archetypes. The solar PV measures will be deployed using a separate site selection methodology, focused on reduction in demand on constrained networks and reduced losses on distribution substations.

Figure 2.3: Trial intervention categories



Energy efficiency monitoring and data collection

There will be regular updates during the deployment phase, identifying where and when each measure is deployed across the trial areas. From this information we will accurately track at feeder level, the network loading changes identified from the point of installation and how these change over time.

We will conduct substation monitoring for a period of 12 months before deploying any interventions. The monitoring period for all participants in the trial will be up to two years with a minimum period of one year from installation. This will ensure we incorporate all peak loading conditions and can measure the impact of seasonal changes. For some interventions monitoring will continue once the trial has concluded to demonstrate sustained change.

As there are a number of substations on our network where suitable monitoring is already deployed, we will avoid additional project cost by incorporating these sites in the trial where possible.

As the smart meter rollout is underway and progressing towards its 2020 deadline, we anticipate that there will be a significant proportion of customers in the trial who have smart meters installed. Where this is the case, and we are able to access the data, we may be able to avoid the cost of some standalone monitoring by accessing smart meter data and including it in our analysis. Where these savings can be realised, they will be returned as a reduction in project spend.

Data collation and analysis

Throughout the trial we will collate the monitoring data gathered, ensuring that the data flows remain consistent and addressing any potential issues before they have an impact on the trial. We will develop and implement an approach to data transfer, cleansing and reviewing to ensure that the outcomes from the trials have the necessary level of robustness. Our delivery partners, Delta-ee and BRE Consulting, bring significant experience of electricity network considerations and knowledge in the field of built environment (aspects of our surroundings that are man-made, as distinguished from the natural environment). This knowledge will ensure that the data arising from the project is analysed robustly, drawing logical and defensible conclusions from the data.

The specific tasks within the data analysis are:

1. Establishment of the counterfactual: without a robust counterfactual the impact of energy efficiency interventions cannot be assessed. We will conduct substation level monitoring for a period of time before the trial to establish a set of baseline data.

2. Identification of the key variables: variables to be explored in the trial include identification of patterns between reduced peak load and energy consumption and a range of other factors such as the energy efficiency intervention, the building type, the primary heating type, the age of the property, the social-economic grouping etc.

3. Definition of performance: there are multiple ways that energy efficiency can be measured. The reduced peak load and energy consumed are typically the primary metrics for a DNO. There are associated 'hard' metrics around carbon savings and energy cost savings. There are also 'softer' performance metrics such as: increased comfort; reduction in fuel poverty and associated reduced impact on the NHS; and increased expenditure in the local economy (due to lower expenditure on energy). Each of these wider benefits will be considered. The trials aim to establish that deployment of energy efficiency can work, with minor alterations to the framework of the existing Ofgem CBA model. However, we also expect the trials to enable the realisation of the wider benefits that could be considered as part of a revised CBA model.

4. Data governance & quality: a critical aspect of any trial analysis is to manage all aspects of the data. The project team will adopt a cradle-to-grave approach, covering data transfer, data cleansing, data review, data retention and quality, and data destruction at the end of the project, where required.

5. Reporting requirements defined: the reporting requirements (timings, frequency, content etc) will be defined to ensure that the analysis produces the required outputs.

Power Saver Tool

The result of the data gathered and analysis carried out under PS+ will produce an energy efficiency intervention 'buy order' tool. This Power Saver Tool is a novel approach to assessing the potential of energy efficiency to address network constraints compared to smart or traditional options, considering the direct network benefits and other non-network benefits. The tool will be designed so that it is user-friendly and intuitive, and although it will be based upon findings gathered at a network level, it will be specified to be usable by multiple stakeholders from those with a network focus to those in the built environment or a customer focus. The Power Saver Tool is the key output from the analysis phase. The key creation stages of the tool will be as follows:

User requirements: we will define the range of ways in which the tool will be used to inform decision-making in the functional design and interface of the tool, using inputs from a range of stakeholders including other DNOs. We will establish a small 'user focus group' that provides input into this part of the project. The output from these groups will define the user profiles and their requirements from the tool, the ways in which they will use the model, and the jobs that the tool will enable them to carry out.

Inputs: the tool will utilise data and insight from PS+ and other NIC projects as inputs. We will design the tool so that it can draw upon additional sources of data and inputs; it will be important to understand what future data inputs may be fed into the tool, to ensure future flexibility in the current model and to allow for updates.

Boundaries for assessment: we will understand and clearly define the boundaries of the evaluation so that the specification is clear about what is included in the tool. Any technical and economic evaluation will consider the relevant viewpoints, eg financial savings from a customer perspective (very direct), or from a UK economy perspective (including a number of indirect factors such as health value and job creation).

Functional specification: this will provide an outline description of how the tool will work, with the processes and functions described. It will describe the types of data required, the types of inputs for users to engage with (and how these may be presented), the basic calculation processes and overarching structure of the tool, and the nature of outputs (eg charts, visual outputs, datasets etc) required. It is likely that the functional specification will be updated as the model is developed.

Functional specification testing: a number of simple test scenarios will be examined to ensure that the proposed outline can meet the needs of the evaluation.

Once built, the Power Saver Tool will be peer reviewed by academics within relevant fields to test and suggest improvements using the existing datasets.

Ofgem CBA model

The Ofgem cost benefit analysis (CBA) model has historically been used as an evaluation tool prior to the regulatory 'RIIO' period. The current Ofgem model used for RIIO-ED1, considers elements directly attributable to the distribution network, including cost of assets, costs attributed to losses and a fixed cost of carbon. It is generally recognised that this model is no longer up-to-date or representative of the range of relevant impacts, indeed Ofgem require DNOs in some circumstances to modify fixed inputs to the model as they deem necessary. Other sectors, including water, are developing their own CBA models and there are now a number of potential improvements that could be made to the data and methodologies used for the current model. PS+ will explore options to adapt and expand the existing model to include wider benefits, taking a more holistic and coherent approach, adding additional layers and putting forward a robust methodology to support incorporation of these wider benefits. During each phase of the CBA model development we will engage with the wider industry and work with other stakeholders to agree upon a preferred approach based upon the work already carried out.

We anticipate the development of the CBA model to be an iterative process, with multiple phases throughout the course of the project. These phases will produce specific outputs during the project, linked to the project deliverables. The high level phases we anticipate for CBA model development are shown below.

Figure 2.4: CBA model development

Phase	Description	Outputs
Phase 1 and good practice guide	Update to include first layer of related benefits, closest to those of the distribution networks, including, but not limited to, transmission and energy costs. This model will be supported by a good practice user guide.	• Updated CBA model • Good practice guide supporting the CBA
Phase 2	Update to include wider benefits of elements including, but not limited to, natural, human and social capital and wider societal value.	• Updated CBA model • Revised good practice guide supporting the CBA
Phase 3	Regulatory calibration – benchmark against	• Gap analysis report

Phase	Description	Outputs
	those used in other utilities. Gap analysis with recommendations for further development.	

2.3: Description of design of trials

The trials will demonstrate the Method that will take place on a representative sample of customer sites and distribution substations and will explore the following hypotheses:

A DNO-led, targeted energy efficiency programme will:

- Demonstrate that strategically targeted energy efficiency interventions and low carbon generation can be a cost effective alternative to traditional reinforcement
- Lower customer energy consumption and costs
- Lead to a better understanding of how to engage/target different energy users and house types with energy efficiency to optimise the benefit of energy efficiency to DNO customers
- Quantify the wider societal benefits of energy efficiency
- Reduce overall and peak demand on the network
- Deliver carbon savings by targeting energy efficiency at constrained parts of the network (by definition heavily loaded)
- Deliver a reduction in network losses.

Identification of target areas

A wide range of data sources will be used to identify the target trial areas. As the primary focus of this project is the mitigation of increased demand on our network, we will identify a list of substations likely to be subject to constraint. This will then be profiled against a range of data sources, including, but not limited to, proportion of domestic/commercial premises, distributed generation, building stock, type of tenure, socio-economic group and ACORN information (consumer classification that segments the UK population by demographics, social factors, population and consumer behaviour).

To ensure that our findings are applicable across GB, we will select a minimum number of representative trial areas of different geographies and demographic makeups.

Monitoring

PS+ will deploy and provide robust peak loading and consumption data from new and existing energy monitoring devices deployed in our distribution substations. We will also measure electricity consumption and peak loading data at customer level by deploying a small number of energy monitoring devices (only within the heating trial) and accessing smart meter data where available. The monitoring will measure the change at substation level between the customer and network measured usage and peak loading before and after interventions are deployed. This data will then be analysed and fed into the outputs from the project.

Retrofit energy efficiency interventions

During the trial phase, data will be collected from customers around their energy usage and the types of electricity-consuming devices they currently use in their homes and businesses. This information will be used to inform the set of measures deployed in the premises of representative groups of customers within the trials. We will also extend this outside the home, deploying retrofit LED street lighting at scale and explore how strategically deployed solar PV can achieve the same result in terms of reduced demand, avoided losses and deferred reinforcement.

Figure 2.5: PS+ trials

Method	Energy efficiency interventions
Trial 1	Retrofit energy efficient appliances in customer premises
Trial 2	Retrofit energy efficient electrical heating in customer premises
Trial 3	Retrofit energy efficient lighting in customer premises
Trial 4	Energy efficiency behavioural advice delivered to customers
Trial 5	Retrofit energy efficient street lighting
Trial 6	Retrofit roof-mounted solar PV installations on municipal buildings
Trial 7	Retrofit roof-mounted solar PV installations on substations
Trial 8	Combined measures (lighting, appliance and behaviour)

2.4: Changes since Initial Screening Process (ISP)

Solar PV

The concept of solar PV has been added to the scope since the ISP was submitted. We have included this stream of the trial as we believe there is a fit with the wider project, and forerunner projects have not linked PV installation with targeted customer energy efficiency initiatives. It is well documented that the deployment of PV can have unwanted effects on distribution networks, but we intend to demonstrate that when scoped and deployed appropriately (in larger municipal buildings and substations) PV can deliver a range of benefits to customers and building occupants.

It was decided that domestic level PV was not appropriate to this project as there have already been a number of funded projects in this area with learning which we can bring to the trial and build upon within PS+.

Insulation

In our ISP, insulation of customers' homes was mentioned as an intervention. The benefits of thermal insulation in buildings are well known and we determined that funding would not be appropriate as additional learning could not be demonstrated. Insulation is also one of the core measures deployed under the ECO scheme, which would mean that our project could subsidise or contradict a supplier's existing obligation. The deployment of insulation requires careful scoping and planning by experts in this field to avoid unwanted consequences, plus the installation of insulation measures can involve significant disruption to customers' homes. We determined that inclusion was not necessary to achieve the aim of our trial.

In Ofgem's ISP comments, it was noted that insulating a gas heated home under the PS+ trial would confer benefits to a GDNO rather than Electricity North West as the DNO. We concur with this view, and would add that as an electricity DNO we would be well placed to deliver electrical energy efficiency, a GDNO would be equally well placed to deploy efficiency with benefits falling to the gas network and its customers.

Following the above changes to the project scope and a detailed costing exercise, including partner contributions, the overall costs have reduced to £8 187 471.

Section 3: Project business case

Context

A switch to low carbon transport and heating will start to increase electricity demand on the network beyond 2020 and to alter traditional load profiles. The recent announcement setting out plans to unlock flexibility including ending the sale of petrol and diesel vehicles by 2040 will drive greater domestic electrification[3]. This will result in capacity limits being breached in sections of the distribution network. Here load diversity is lowest thus forecast increases will lead to thermal and or voltage constraints. When these changes lead to levels of demand which exceed the network's capacity and or voltage limits, DNOs need to respond quickly, cost-effectively and with minimum disruption to customers.

A low voltage thermal constraint is traditionally defined as peak load exceeding the asset nameplate rating. Once a distribution asset becomes thermally constrained, the traditional solution is to replace with a higher capacity asset. If this is not possible, an additional distribution substation or feeder can be installed to meet the new demand. These traditional options involve significant cost and disruption to customers.

The Electricity North West forerunner projects, Celsius and Smart Street, are looking at options on the low voltage networks which reduce the need for traditional reinforcement through a more dynamic use and reconfiguration of existing assets. PS+ explores a complementary option which reduces overall consumer consumption, enabling further reductions in traditional reinforcement while reducing losses and providing a number of secondary and tertiary benefits to the end customer.

Consumer benefits

PS+ will release capacity through a reduction of customer energy consumption more quickly and at lower cost than traditional reinforcement. Faced with increasing volumes of load-related reinforcement requirements beyond 2020, network operators could find that skilled resource and manufacturing constraints limit their ability to deliver network capacity at the rate required by customers. PS+ will build on the learning from the Electricity North West Power Saver Challenge[4] project, providing an alternative solution to traditional reinforcement. Learning from other projects that have engaged with the domestic consumer has been incorporated into the design, limiting overlap and ensuring an additional benefit can be achieved. A review of complementary projects can be found in Appendix D.

To deliver the most efficient solution for the customer, a Power Saver Tool which combines network, intervention and customer data will be developed following the trial phase. This tool will be built with expandability in mind, potentially allowing the inclusion of smart meter data and flexibility information as required. This tool will enable a DNO to determine where, when and which measures to deploy within their network region to deliver maximum benefit to the network and its customers.

PS+ delivers savings for customers

PS+ focuses on the delivery of savings to customers through several means including the reduction of network reinforcement costs. This is achieved through implementation of six methods and associated energy efficient devices. While a blended mix of methods will likely be the most appropriate end solution, this project will also trial the delivery of each independently to ensure results are replicable and appropriate.

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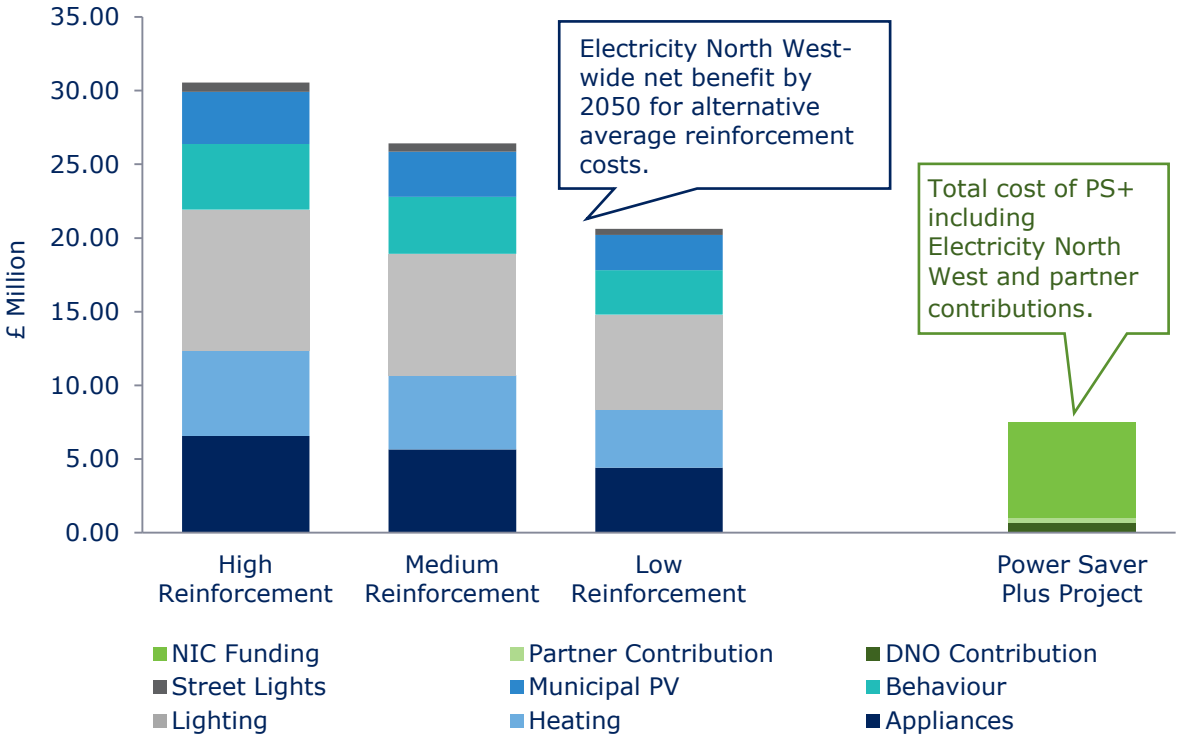
[3] See "UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations", "Upgrading our energy system: smart systems and flexibility plan" and National Grid Future Energy Scenarios 2017

[4] Power Saver Challenge closedown report pdf

The value of the PS+ project once rolled out across the Electricity North West network, is dependent on the cost of the reinforcement deferred. To ensure the benefit is correctly quantified, three alternative networks have been modelled (Denton East, Hindley Green and Wigton as discussed in Appendix A), and the resulting reinforcement requirements cost estimated. As the level of reinforcement will vary depending on geographic location, level of low carbon technology uptake and timing, the modelled results offer a range from which to calculate the net benefits.

Figure 3.1: Business case waterfall for Electricity North West rollout vs PS+ project cost



The three columns to the left in Figure 3.1 demonstrate the range of net benefits and the extent to which each method contributes to the total. The figures stated are NPV benefits of an Electricity North West rollout to the year 2050. Project costs for PS+ on the right of the graph match the full submission spreadsheet and represent the full project costs, including the items of scope which will be funded by Electricity North West and our project partners.

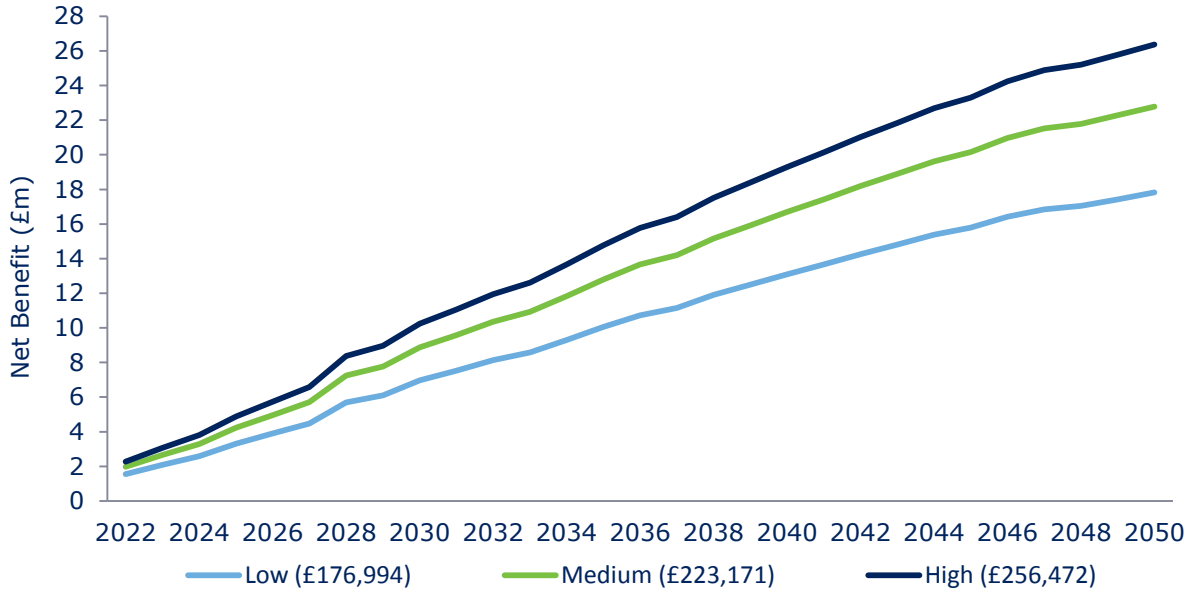
Analysis of anticipated benefits against the project cost shows PS+ has the potential to deliver value to the consumer, **offering between £12 and £25 million of savings** once rolled out across the Electricity North West network.

Network benefits

Of the six trial methods to be deployed, four require delivery direct to the end customer for use within their property. The two other methods look at unlocking benefits from within the local community through reduction in street light energy consumption and installation of PV panels on municipal buildings. As there is a variety of evidence to support benefits of the latter two, their trials aim to inform where and when it may be suitable for a DNO to part or fully fund the methods to defer network reinforcement.

The in-home interventions all have theoretical energy consumption savings, yet the actual impact visible on the distribution network is largely undefined due to variations in housing classification, size, tenure and demographics. Taking the four in-home methods (appliances, heating, lighting and behaviour) the cumulative net benefit for each alternative reinforcement option is shown in Figure 3.2.

Figure 3.2: Net benefit range for alternative average reinforcement costs



The timing of PS+ is crucial as Figure 3.2 highlights. On completion of the trial phase, substantial benefits could be realised immediately with near linear increase in net financial benefit to 2050 for all three reinforcement options. These reinforcement values and the NPV calculations which replicate the approach taken in the RIIO-ED1 Ofgem CBA template are detailed in Appendix A.2.

The benefits achieved are directly related to the number of deferred reinforcement schemes. Electricity North West's future capacity headroom (FCH) model was utilised to derive the number of predicted asset overloads in a scenario of high EV and HP uptake combined with current expected energy efficiency gains. Through application of the in-home measures and reinforcement cost of £223 171, the simulated results imply that the reinforcement associated with 500 secondary substations between 2022 - 2050 can be deferred. The methodology and assumptions are detailed in Appendix A.2.

Figure 3.3: Reinforcements deferred by substation type

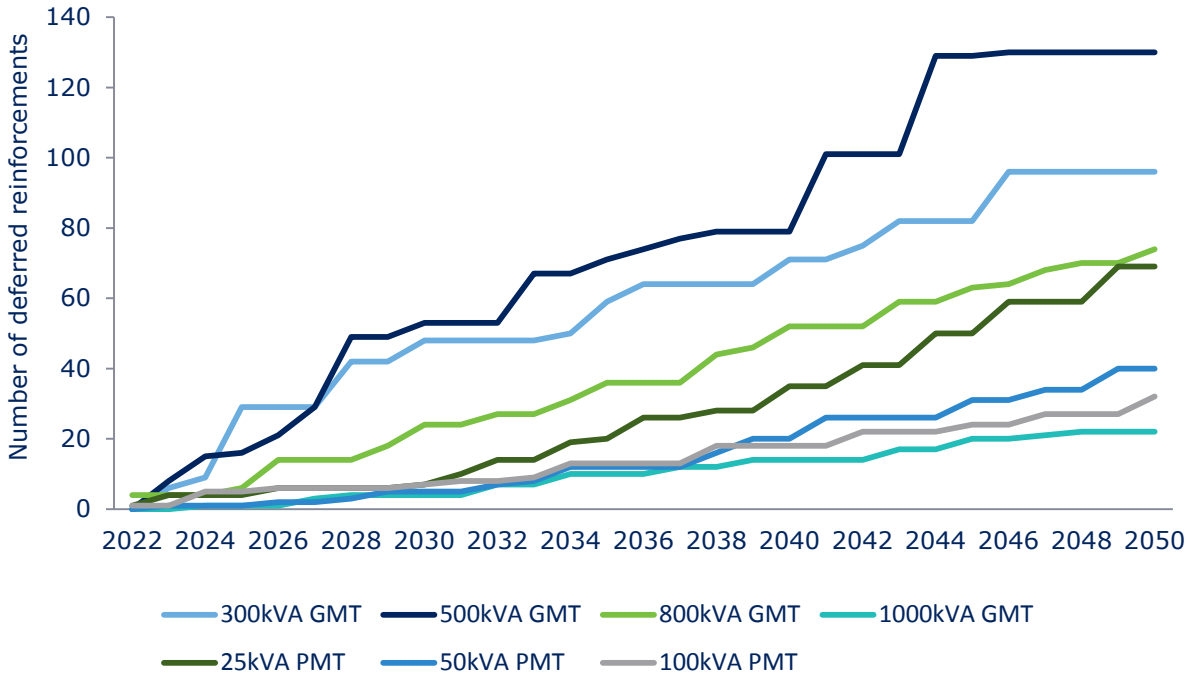
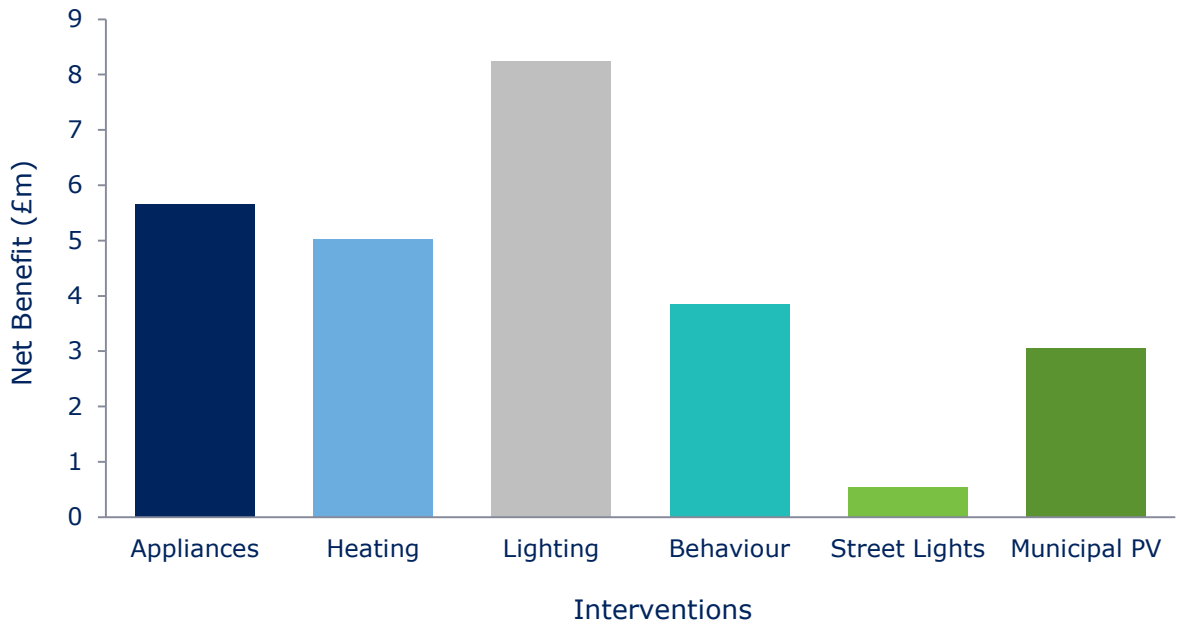


Figure 3.3 splits the total number of reinforcements deferred by substation type, depicting where the greatest benefits may be achieved through network-wide application of the methods. However, at present this is a two dimensional view which stops at the transformer rating and does not take downstream network or the customer into account. Through physical trials we can overlay a range of dimensions to form a Power Saver Tool able to provide more informed direction and unlock presently unattainable value.

Continuing to apply the medium reinforcement cost, a direct comparison of the simulated benefits for each of the six methods emphasises their importance and justifies the distribution of project funds. It is recognised that not every method would be appropriate for all instances and uptake weightings have been applied to compensate. Heating has a limited level of deployment due to a relatively low penetration of electrically heated homes, yet due to vast improvements in heating technology, substantial savings can be achieved. Conversely, lighting can be deployed to all and while the individual savings are small, the combined reduction could offer large, as yet untapped savings.

Figure 3.4: Net benefits per intervention across the Electricity North West region



Importantly, disseminated learning and direct communication with project teams conducting lighting and behaviour trials (SSEN SAVE and UKPN Energywise) has presented a knowledge gap which PS+ aims to reduce.

Once the business case is proven, PS+ will demonstrate notable net benefits across Electricity North West. Similarly, the net benefits of wider deployment across GB can be determined through scaling up the project based on assumptions in Appendix A.1.

Figure 3.5: Net benefits by 2050 through PS+ rollout

	Net benefits (£m)	Energy saving (MWh)
PS+ project	£2.79	4,401
Electricity North West	£26.42	75,966
Great Britain (GB)	£350.80	1,008,828

Customer benefits

PS+ predominately focuses on the deferral of distribution network reinforcement, but through reduction of domestic energy consumption, the end-customer could achieve notable savings directly through their energy bill. The achievable savings for each of the four in-home methods is presented in Figure 3.6 with the appliances category split out into five different products, all of which will be independently trialled.

Figure 3.6: Customer benefits per intervention

Intervention	Tool	Cost	Benefits			
			AD Peak Reduction kW	kWh/yr reduction	£/yr/ Device (Avoided Generation)	£/yr/ Device (Domestic Bill)
	Behavioural campaign	£270.00	0.075	176.0	£10.12	**£25.29**
	LED Solution (Panel & 8 bulbs)	£50.00	0.270	150.0	£8.62	**£21.56**
	Heating	£869.00	0.385	983.0	£56.50	**£141.26**
	Fridge	£380.00	0.148	120.0	£7.64	**£17.24**
	Freezer	£380.00	0.148	202.0	£7.64	**£29.03**
	Washing machine	£350.00	0.148	107.0	£7.64	**£15.38**
	Dishwasher	£440.00	0.148	106.0	£7.64	**£15.23**
	Tumble dryer	£500.00	0.148	220.0	£7.64	**£31.61**

To deliver the inputs required for the Power Saver Tool, all of the interventions must be trialled separately. In reality, customers may adopt multiple interventions and realise greater direct benefits.

Substation PV

Currently domestic customers pay for losses equally as a proportion of their overall energy consumption which is calculated through the line loss factor. To reduce losses, PS+ proposes to install PV on substation roofs, connecting them to the low voltage side of the local distribution transformer. The trial will put forward recommendations as to how savings could be passed to customers through proposed modifications to the line loss factor.

The losses of the transformer and upstream network are offset in part by the PV generation, essentially reducing 3-5% of visible losses. Applying methods used within the RIIO-ED1 Ofgem CBA template, the NPV of a substation PV installation to 2050 is **£32 000** (See Appendix A.2). This is achieved through the costs in the Ofgem CBA template associated with reduced losses and traditional generation.

Further benefits

A valuable indirect benefit from this project will be the insight that it will deliver to DNOs, suppliers and other key stakeholders regarding the behaviours of various diverse groups of customers and their interaction with energy efficiency interventions. PS+ trials have been designed with academic rigour to ensure that they are statistically significant and deliver findings that can be extrapolated and used across all customer groups. Research conducted by RAND Europe[5] on behalf of DECC in 2012 identifies numerous gaps in available evidence on how alternative demographic groups respond to different energy saving interventions. Typically studies have not been designed with this as a core aim, thus there is an opportunity for PS+ to generate supporting evidence through trialling different social demographic groups via housing archetypes.

Carbon benefits

It is estimated that, at the scale of the project, PS+ could reduce energy consumption (through losses and domestic customer consumption) by 4 401 MWh (638+2 707+76+980 from Appendix A.1) to 2050 through the methods depicted in Figure 3.4. This is equivalent to the average annual consumption of 880 domestic properties.

PS+ is less carbon intensive than traditional reinforcement of assets. Embedded carbon associated with new assets is incurred at some point in the future driven by reinforcement for continuing load growth or asset replacement due to condition. However, if load growth plateaus or falls, the asset carbon impact from an unnecessary reinforcement intervention is completely avoided. Thus asset carbon has been excluded from the carbon benefit calculations.

Operational carbon associated with network losses has also been considered although the impact of low carbon technology uptake on future LV network load profiles, and thus losses, is uncertain. Reinforcement can reduce losses through lower utilisation factors of the new assets and opportunistic replacement with a low loss transformer where applicable. However, as PS+ methods reduce overall consumption on the low voltage network, almost all of the losses associated with the delivery of the saved demand are prevented. Analysis of the trial results will aim to aid quantification of the operational losses reduction and facilitate direct comparison with asset replacement.

Overall, in the FCH scenario employed, PS+ decreases carbon emissions by 1 138 tCO2 (169+717+17+235 from Appendix A.1) to 2050 through applying the same methods used in the RIIO-ED1 Ofgem CBA template.

[5] What Works in Changing Energy Using Behaviours in the Home? A Rapid Evidence Assessment

https://www.gov.uk/government/publications/what-works-in-changing-energyusing-behaviours-in-the-home-a-rapid-evidence-assessment

Section 4: Benefits, timeliness, and partners

(a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits while having the potential to deliver net financial benefits to future and/or existing Customers

Encouraged by government policy and incentives, the rapid development of a low carbon energy sector is gathering pace. The transition to a low carbon economy and the anticipated electrification of heat and transport will require DNOs to invest in the reinforcement of networks which in turn will have an impact on customers' bills. By engaging with our customers on energy efficiency, we can help to meet this substantial challenge.

PS+ delivers against a number of aspects of the Carbon Plan, principally, accelerating the progress of energy efficiency of customers and their buildings which will achieve carbon savings earlier than expected. The use of energy efficiency as an alternative to traditional reinforcement has the potential to release additional capacity more quickly, improve energy security and decrease losses, enabling easier connection of more LCTs to the network.

This project will take a whole system view of the energy network, customer and carbon impact of efficiency interventions and will validate geographically targeted energy efficiency investment as an alternative to, or as a supplement to, traditional reinforcement.

Creating additional network capacity will reduce the overall cost of decarbonisation by supporting the uptake of electric heating and transport with resulting improvements in local air quality. Further environmental benefits come from delayed or avoided requirement for costly and disruptive network reinforcement and the associated noise, disruption and inconvenience of street excavations and temporary supply interruptions. These can have a significant negative impact on homes and businesses.

The benefit(s)

- Alleviate fuel poverty for Electricity North West customers, improving economic and social outcomes within our region
- Decrease losses, enabling the more efficient running of the network and decreasing costs to our customers
- Create headroom to enable the connection of more LCTs to our network, enabling us to manage and operate our network more proactively
- Enhance asset lifespan, delivering more value from installed assets and avoiding planned outages for asset reinforcement
- Spread the cost of energy efficiency interventions over a longer period as part of the DNO's asset base rather than recovery of costs over a short period as currently adopted by suppliers under ECO.

Contributing to the Carbon Plan

The Carbon Plan, published by the UK Government in 2011, describes the importance of moving to a low carbon economy and sets out how legally binding targets in the reduction of greenhouse gas emissions will be achieved. The CCC has also identified that the energy sector will be the biggest contributor towards achieving the UK's carbon reduction targets, with some scenarios suggesting that the energy sector could reach net zero carbon emissions by 2050. PS+ will enable the connection of more LCTs to the network by helping to create the headroom needed to facilitate technologies such as heat pumps and EV charging.

Delivering significant financial and network capacity benefits

The financial and network capacity benefits that PS+ could provide are quantified in this section and Appendices A.1 (Benefits Tables) and A.2 (Method and Base Case Methodologies). These benefits are then extrapolated across Electricity North West and GB.

PS+ project

To scale down the benefit to PS+, only the substations identified as triggering reinforcement within the trial period have been included. PS+ will aim to incorporate these into the trial and target those forecast to exceed asset limits in the years that follow. To ensure a robust set of trials and an achievable programme, 40% of the identified substations falling in the first year of the trials would be targeted and 50% of those within the proceeding years.

£2.79 million of net benefits is achievable through the PS+ project, alongside a significant **4 401 MWh** reduction in consumption.

Electricity North West scale

The cost benefit analysis conducted is based on the Ofgem RIIO-ED1 CBA template v4 and the Electricity North West FCH model. As the latter represents the entire Electricity North West network, the CBA has been constructed around this to increase accuracy and facilitate updates and alterations as required.

Net benefits are therefore taken directly from the PS+ CBA models and are based on the sets of assumptions outlined in Appendix A.2. Through deployment of the methods, more than **4 000** secondary substation-related reinforcements can be deferred or avoided between 2019 and 2050. This is modelled to equate to **a £26.42 million** net benefit, potentially offering at least **£12 million of savings** after subtraction of project costs. The domestic energy consumption is effected to reduce by **75 966 MWh** from the trial phase to the year 2050.

Great Britain

As the underlying models have been built up on Electricity North West-wide adoption of the PS+ methods, the extrapolation across all six distribution network operator companies and the 14 licences they own and operate was achieved through use of a single multiplier. This multiplier is as determined by TNEI Services as part of the *eta: creating efficient distribution networks* Second Tier LCN Fund project presented in 2013 (now known as Smart Street). To scale from PS+ to Great Britain is by application of a multiplier of 13.28.

As a result, if the PS+ methods were rolled out across Great Britain, the total net benefits could be **£350.8 million**, reducing country-wide domestic energy consumption by **1 008 828 MWh** by 2050.

In addition, each customer the method is applied to could save a minimum of £15 per annum on their electricity bill resulting in multi-million pound savings for customers.

(b) Provides value for money to electricity distribution / transmission customers

Improvements in customers' electrical energy efficiency will have a direct impact on their own energy costs and provide a benefit to local distribution networks in terms of reducing overall demand and peak energy distributed. This will reduce the need for costly network reinforcement driven by low carbon technology uptake. Reducing consumption and peak demand will reduce network losses (including transmission system losses). Reducing peak demand will also reduce the obligation on the system operator to secure resources for system peak demand management, an additional cost which is apportioned to customers.

Within the PS+ trials, Electricity North West will apply best practice project management techniques to ensure timely and cost-effective delivery of project outcomes. Regular project steering group meetings including risk and mitigation reviews will be conducted. In addition to members of the project team and project partners, this group will include oversight by a project director and federated management accountant from the finance directorate for driving delivery to budget.

Taking into consideration the findings of the 'Each Home Counts' review published in 2016, we will ensure we include the recommendations set out below and embrace these principles across each intervention area to maximise impact and value for money.

- Coordination (including with local authorities)
- Standards (ensuring relevant standards are applied)
- Quality control (ensuring adequately skilled installers)
- Household specific solutions (one size does not fit all)
- Education (customer advice and guidance).

Processes to ensure competitive cost

During the bid development phase, a call for innovation was advertised on the ENA Smarter Networks Portal and the Achilles utilities vendor database to invite proposals from appropriate specialists to support the PS+ trials. The responses were evaluated against the criteria of relevant experience and expertise, cost and partner contribution. Delta-ee, BRE, Energy Saving Trust, Impact Research and the University of Salford were assessed as offering the best value for money with relevant experience and selected as partners for delivering PS+.

The development of the CBA model was identified as a key workstream in the project, and as such the output required specialist assistance from an economic consultant in the field of cost benefit analyses, ideally with experience in the utilities sector.

We ran a further procurement process for the selection of the consultant required and received responses from three economic consultancies. We evaluated these responses on a like-for-like basis including cost, relevant experience and understanding of our requirements. We awarded the workstream to NERA on the basis that we had carried out a full selection process and identified the solution with the best fit and with best value for our project. Their proposal put forward a set of fixed day rates for the duration of the project, with no inflationary increase applied. In addition NERA proposed to bring forward evidence from previous work they have carried out in this area (including previous research into international regulatory arrangements governing efficiency schemes) and we were able to recognise the value of this work as a contribution to our project.

Other costs have been derived from our business as usual framework agreements. These contracts will be awarded based on open competitive procurement exercises, compliant with EU procurement regulations and the utilities directive. We will continue with competitive processes and/or benchmarking of costs during project delivery. For instance, procurement processes will be conducted to select organisations to deliver the energy efficiency interventions to ensure value for money is obtained for GB customers.

Clear roles and responsibilities for all project participants will ensure that there is no duplication of activities. The table below shows the expected number of person days and day rates per partner/supplier.

Figure 4.1: Partner costs

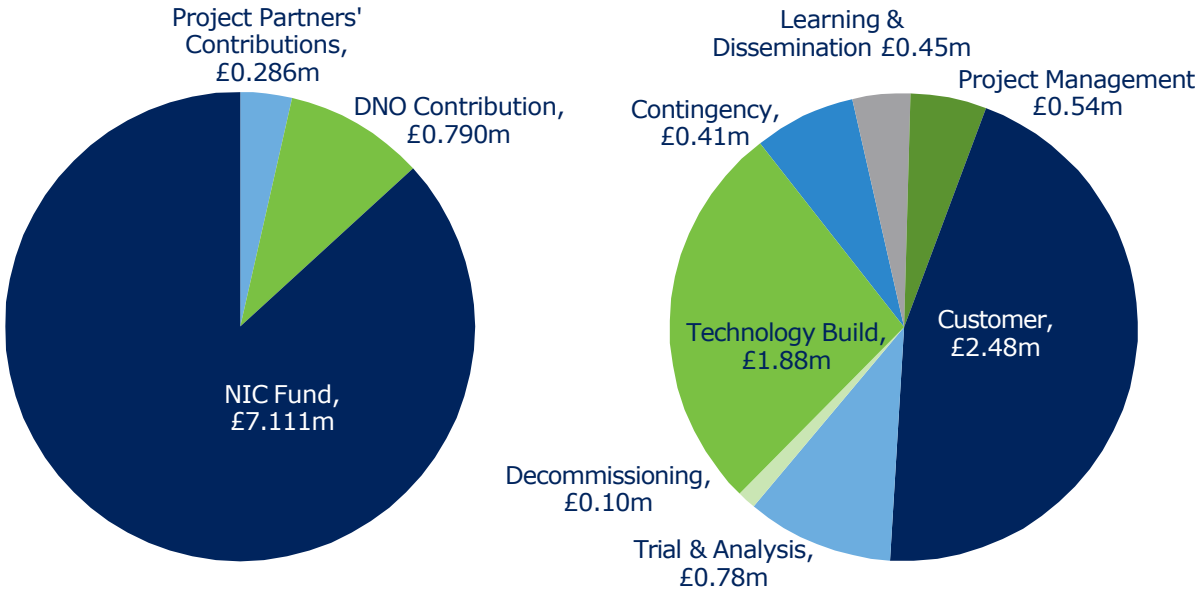
Organis-ation	Electricity North West	Impact Research	BRE	Delta-ee	University of Salford	Energy Saving Trust	NERA
No of days	3 690	3 359	186	219	156	194	78
Day rates (average)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Electricity North West has negotiated a contribution from each of the partner organisations named above. This contribution, along with the DNO compulsory contribution, reduces the cost of the project to customers by £1.076m.

Project funding and cost

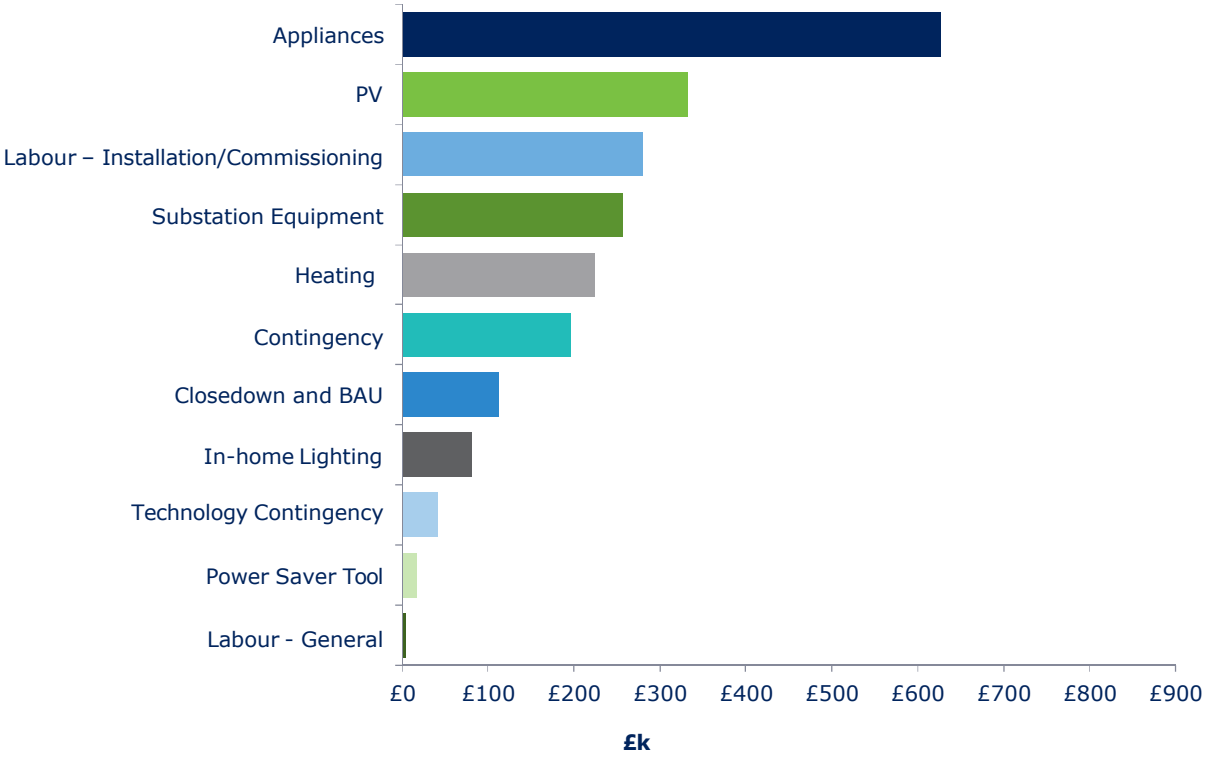
Figure 4.2 shows the cost of delivering PS+ is £8.096m (£8.187m with interest) with £0.790m funded by Electricity North West and the project partners.

Figure 4.2: PS+ funding proposal and high level cost overview



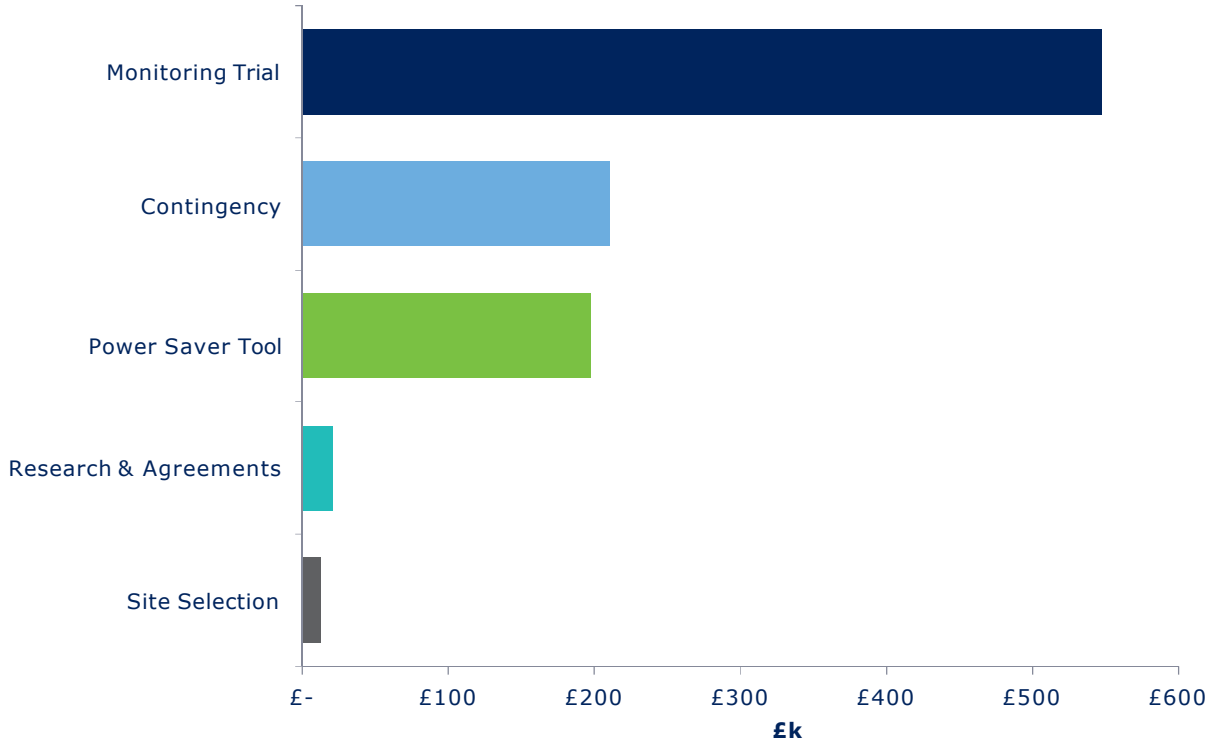
The individual workstream costs are broken down in Figures 4.3 – 4.6.

Figure 4.3: Technology workstream costs overview including contingency



The main costs in the technology workstream are the purchase and installation of the energy efficiency interventions and the purchase and installation of the monitoring equipment.

Figure 4.4: Trials and analysis workstream costs overview including contingency



The majority of the cost in the trials and analysis workstream is associated with performing analysis of raw data which feeds into the production of the Power Saver Tool and CBA model.

The cost breakdown for customer engagement activities are shown below in Figure 4.5.

Figure 4.5: Customer workstream cost overview including contingency

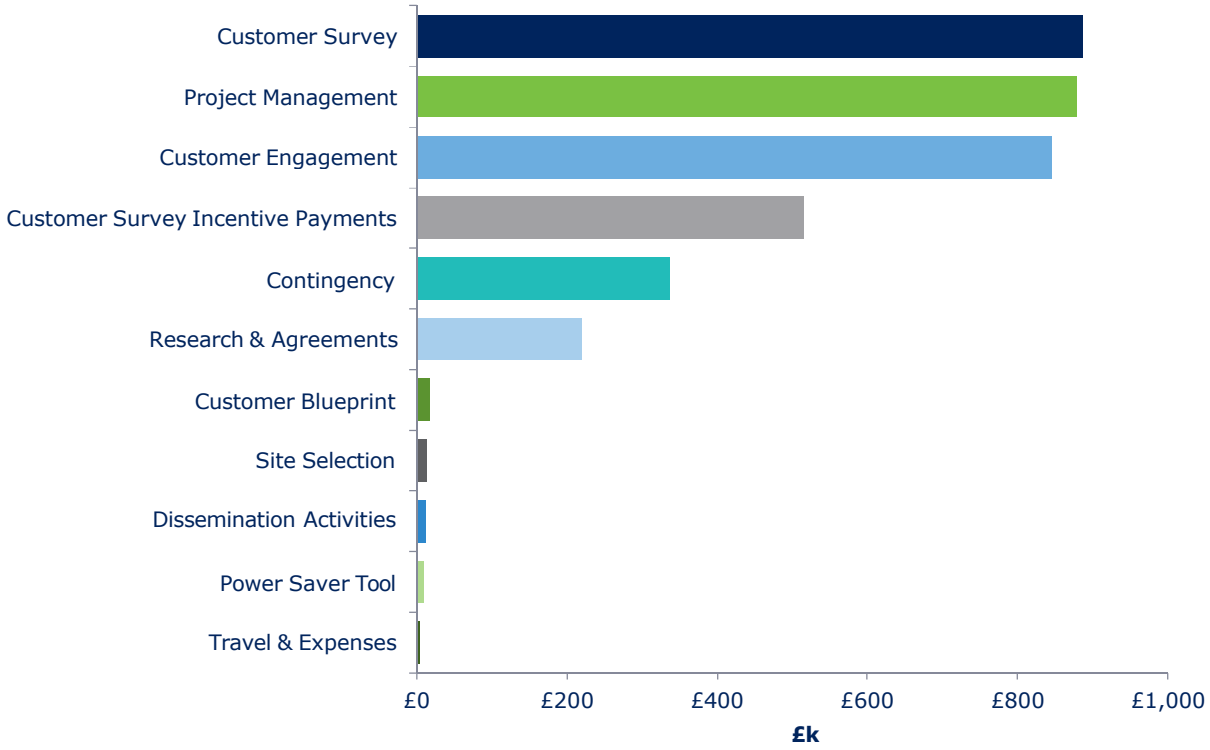
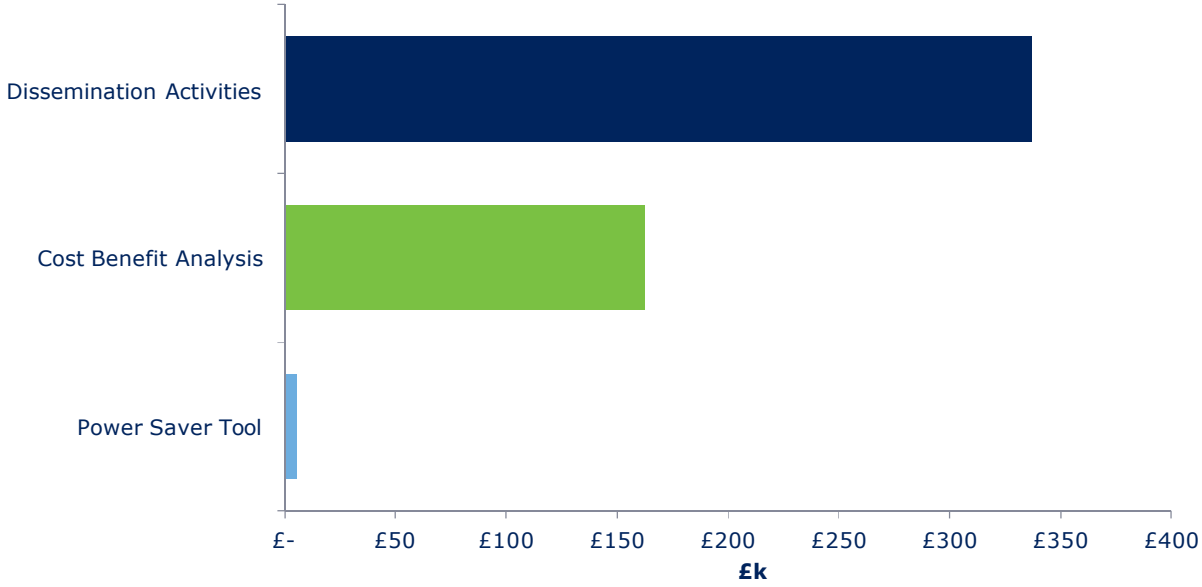


Figure 4.6: Learning and dissemination workstream costs overview



PS+ provides tangible outputs through the learning and dissemination workstream.

Direct benefits

As the PS+ concept is not yet proven, the site selection methodology will exclude any distribution substations with assets due for load-related reinforcement during the delivery of the project. No allowance has been sought through Electricity North West's well justified business plan for RIIO-ED1 for the purchase and installation of energy efficiency interventions. Therefore no expenditure included in the business plan for RIIO-ED1 will be avoided as a result of undertaking this project and none of Electricity North West's DNO contribution will be funded by direct benefits.

(d) Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness

The nature of energy policy and energy efficiency funding measures has been inconsistent in recent years, leading to a 'boom and bust' renewable and energy efficiency industry, with incentives and levies being introduced, capped and scrapped, leaving few market players able to build and maintain a presence and reputation in the market.

A review of electricity utilities in the UK has been undertaken and showed that although there has been some work in the area of energy efficiency, it has mainly concentrated on elective groups of customers (such as vulnerable customers); none have explored the potential for the application of energy efficiency interventions across a broad spectrum of customers, or achievable net benefits in terms of avoided network reinforcement and overall reduction in system demand. See Appendix D for further information.

Our forerunner project Power Saver Challenge also challenged the principle that domestic energy efficiency interventions should be the sole domain of energy suppliers. The rationale for the project lies in the belief that network operators are in a better position to more effectively and economically target and finance effective energy efficiency interventions to derive whole system benefits. As the DNO is responsible for the regional customer base and the assets used for delivering these customers with a secure and reliable supply, it is better placed and has greater incentive to encourage energy efficiency than a supplier, which has a transitory customer base, comprised of only a proportion of the businesses and households in the region. Furthermore suppliers' profits

are driven by increased consumption, which conflicts with their obligation to promote energy efficiency.

Current regulatory principles and DNO licence provisions do not provide clear direction for funding energy efficiency interventions through the regulated asset value mechanism. Moreover, the project is needed to be able to demonstrate that such measures can deliver the expected benefits and be robustly proven as a credible alternative or supplementary investment choice to traditional reinforcement.

PS+ has the potential to bring about significant cost savings for GB DNOs and GB customers along with carbon and network benefits. However, there are many elements to explore within PS+ and the results of the trials are not yet known. Forerunner projects have touched on areas of energy efficiency at customer level and uncovered some valuable findings on the specific benefits to the network and specific groups of customers. PS+ intends to take the learning from these projects and apply these using a whole network approach, examining how best to engage with customers across all demographics, the methods to influence energy reduction in different customer circumstances and develop a Power Saver Tool which takes a complete, holistic view of potential variables to maximise the impact from a whole network perspective. Innovation funding for this project will enable us to trial this approach at scale, giving real world insight into effective approaches and informing changes to regulation and policy to enable this or similar approaches to be taken by all DNOs in the future.

(e) Involvement of other partners and external funding

At Electricity North West we encourage our stakeholders to participate in innovation activities and endeavour to make it simple for them to interact with the innovation team to suggest ideas.

There are various channels by which our stakeholders can make contact, including our contact centre which includes an interactive voice response option for innovation, Electricity North West's innovation website, a specific email address and social media channels.

For a single licence DNO, our innovation team and senior managers are exceptionally active and accessible across the industry and within the business for example:

- Industry engagement through presenting at conferences and seminars eg IET and WEET events and chairing forums eg Distributed Generation Forum, Distributed Code Review Panel etc
- Stakeholder engagement through engaged customer panels (both project specific and for our RIIO-ED1 business plan)
- Innovation engineers seeking new developments in technical and commercial approaches by discussing concepts with other DNOs, industry colleagues, product developers and consultants.

Our innovation lifecycle moves from idea generation, to alignment with our strategy, scoping and delivering the project, sharing the learning and then transferring successful outputs to business as usual.

Our future networks steering group assesses project suggestions from these various sources and decides on which to take forward. The selection for the project concept was developed from an initial list of projects, from potential partners and business-led ideas.

Our commercial strategy & support director, Paul Bircham, has been in liaison with a range of stakeholders at BEIS throughout the development of PS+.

We have held three meetings and a workshop with BEIS during 2017 on the PS+ concept. We have also had numerous phone calls and provided briefing by email. Senior BEIS officials including Richard Mellish, deputy director fuel poverty and obligations, and

Patrick Allcorn, head of local energy, have expressed their support for the project, interest in developing and realigning the ECO obligation in 2022 and agreement with the findings of the Power Saver Challenge report. We maintain regular contact with the BEIS team and our most recent discussion took place on 3 October where Patrick Allcorn enquired about progress and expressed his ongoing support for the concepts to be explored in PS+.

The PS+ trials also link closely with the recently published Clean Growth Strategy report which cites that policy has an important role to play in being coherent, cost effective, aligned with customer needs and motivation and should unlock the full value of energy efficiency. It states "energy efficiency improvements bring benefits well beyond bill savings and carbon reduction, including lower costs for maintaining grid infrastructure, improved property values and reduced risk to mortgage lenders of defaults on mortgages."[6]

The work carried out under the PS+ trials will also tie in and provide additional evidence aligned with BEIS' recently published call for evidence entitled 'Building a Market for Energy Efficiency', which invites views and ideas on how those who derive value from energy efficiency, including distribution network operators, can be players in the market, and ideas on "how incentives could be further aligned to unlock this value are explored"[7]

The project concept has been reviewed by consultancy firm Delta-ee and the future networks steering group has selected and approved this innovation idea as the basis for the 2017 submission to the Network Innovation Competition.

The decision on which project partners and/or suppliers to select is taken by the future networks steering group and the identification started in early 2017 through RFI, EOI and calls for innovation. These promote wider awareness and involvement to generate competition via the ENA Smarter Networks Portal and the Achilles utilities vendor database. The selection of project partners and/or suppliers is dependent on experience, skills, cost and the organisation's ability to commit resources to deliver the project and disseminate the learning to other GB DNOs and stakeholders. More information on our partners can be found in Appendix I.

(f) Relevance and timing

PS+ will build on the findings of previous energy efficiency-related innovation projects and studies including our Power Saver Challenge project, SEPD's 'SAVE' project, UKPN's 'Energywise', WPD's 'Community Energy Action' and work carried out by the NEA and Agility ECO. These projects differ in scope, methodology and project outputs but have areas of commonality with the PS+ project, which will enable us to refine and improve our approach to deliver more effective outcomes for our customers and network. In addition, Citizens Advice has highlighted the need to better capture evidence of the consumer experience and engagement from such projects to feed into future funded projects and those activities which should become business as usual for network operators.

The timelines for the PS+ project allows the creation of the relevant tools and models to inform the RIIO-ED2 business plan. An overview of financial and carbon/environmental benefits can be found in Appendix A.1.

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6 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/651916/BEIS_The_Clean_Growth_online_12.10.17.pdf

7 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/651270/Call_for_Evidence_-_Building_a_Market_for_Energy_Efficiency_Final-1.pdf

Section 5: Knowledge dissemination

5.1: Learning generated

PS+ builds on the learning from previous innovation projects on energy efficiency and will generate incremental learning in a number of areas. Analysis of relevant projects can be found in Appendix D.

The project plan incorporates early dissemination of the learning and knowledge that PS+ expects to generate. Timely dissemination is also reflected in Section 9 (project deliverables). These provide focus on disseminating outputs as early as possible to maximise all benefits uncovered throughout project delivery. The key knowledge outputs are shown below:

- Site selection and trial design finalised
- Customer engagement process and materials
- Energy efficiency interventions
- Customer surveys
- Power Saver Tool
- Updated CBA
- Process for transition to business as usual
- Recommended code of practice for customer data access
- Technology intervention
- Behavioural change
- Insight on customer attitudes to energy use across all customer demographics.

Figure 5.1: Knowledge dissemination key deliverables

Deliverable	Product	Responsible
Annual project progress reports	Reports which comply with the Governance Document requirements	Electricity North West and project partners
Closedown report	Reports which comply with the Governance Document requirements	Electricity North West and project partners
Power Saver Tool	1. Report identifying and analysing customer segments 2. Report detailing the impacts from the interventions 3. Tool and user guide	Electricity North West, BRE, Delta-ee
An enhanced CBA model	1. Updated Ofgem CBA model 2. Good practice guide supporting the CBA to consider the NPV of alternative types of intervention 3. Gap analysis report benchmarking CBA against other utility sector models Engage with wider industry and other stakeholders during the three phases	Electricity North West, NERA
Comparison	Report to assess the merits of suppliers and distribution companies being responsible for delivering energy efficiency programmes	NERA
New knowledge of effective techniques in engaging with customers to obtain their buy-in to energy efficiency interventions	1. Publish a report detailing the most effective methods of customer engagement and recruitment 2. Publish report quantifying the acceptability of DNO-led home energy efficiency interventions	Electricity North West, Impact Research, EST
Install and	1. Produce report detailing time and	Electricity North West,

Deliverable	Product	Responsible
commission monitoring equipment	location of monitoring installs 2. Make monitoring data available 3. Publish report detailing analysis and findings	Delta-ee, BRE
Install and commission energy efficiency interventions	Publish list of interventions deployed within the trial areas	Electricity North West, Impact Research, EST
Install and commission network-based PV	1. Feasibility report on sites suitable for PV network installations 2. Produce a report detailing the benefits of network based PV	Electricity North West, Delta-ee, BRE
Install and commission customer side of the meter PV	1. Feasibility report on site types suitable for PV including projected benefits and recommendations 2. Produce a report detailing network effects of PV deployment on the network	Electricity North West, Delta-ee, BRE
Install, monitor and analyse energy efficient electric heat interventions	Report outlining site selection, deployment, monitoring, analysis and recommendations for energy efficient heat interventions	Electricity North West, University of Salford

5.2: Learning dissemination

The wealth and knowledge that PS+ will generate, described above, will be of interest and benefit to various stakeholder groups. Identifying and understanding these stakeholders is important so that careful consideration can be given to their individual requirements. This will allow us to tailor knowledge sharing and information dissemination to meet the needs of each stakeholder group. With successful delivery and closedown of two Second Tier LCN Fund/NIC projects and a further three currently in flight, we have established a consistent approach to capturing and sharing learning effectively, but will always seek to improve our dissemination channels.

Audiences

Our main stakeholder audiences broadly fall under the following categories:

Distribution network operators: including IDNOs, Ofgem, BEIS and wider government. They will be keen to understand how PS+ can be employed to support the reduction of CO_2 emissions, reducing network costs and contributing to the delivery of the Carbon Plan goals. In freeing up capacity on the electricity network, the project will allow for increased adoption of LCTs. Such energy efficiency interventions, linked to energy policy, could deliver superior overall electricity system benefits, including lower network losses, and reduced reliance on high-carbon generation. This will also assist in decision-making for future strategies, price control reviews and industry regulation.

Academic institutions: such as universities and higher education establishments who are likely to access the raw data generated in PS+ to support wider research in the area of energy efficiency. Knowledge dissemination with this stakeholder group presents a unique opportunity to invite alternative conclusions.

Local authorities, housing associations, charities and customers: these groups will be interested in the insight and benefits that can be gained from the rollout of PS+, such as reduced customer bills, effective channels of engagement, information on customer attitudes, customer acceptability of such an initiative, and how they can play a part in, and drive, further benefits from the project.

Electricity North West: colleagues from across the organisation have been highly engaged and interested in the innovation programme and the PS+ project team will be proactive in disseminating learning to this key stakeholder group. Close links with the customer contact team, those responsible for policy and standards and the finance and procurement departments will help with successful project delivery. The Electricity North West community as a whole have a vested interest in working together to establish how learning and knowledge will be incorporated into future business as usual processes.

Knowledge dissemination

As previously described, knowledge sharing and dissemination activities are designed around the project deliverables. In addition to this planned learning, our experience shows that unplanned learning is also likely. Timely dissemination of all planned and unplanned learning is crucial to keeping stakeholders engaged. To facilitate this, PS+ will have a dedicated learning and dissemination workstream which will promote dissemination activities and identify appropriate audiences to share learning gained though the most appropriate channels, described below:

- Website
- Knowledge sharing events – conferences, webinars, workshops
- Social media
- Press releases/advertorials
- Internal communication
- Reports
- Documents
- Training materials
- One-to-one knowledge sharing sessions.

Figure 5.2: Dissemination programme

2018	2019	2020	2021	2022
PS+ website	Internal communication	Internal communication	Internal communication	Internal communication
Internal communication	Advertorial	Advertorial	Advertorial	Closedown report
LCNI Conference	LCNI Conference	LCNI Conference	LCNI Conference	Knowledge sharing event
Annual report	Annual report	Annual report	Annual report	One to one stakeholders briefings
Knowledge sharing event	Knowledge sharing event	Knowledge sharing event	Knowledge sharing event	
One to one stakeholders briefings	One to one stakeholders briefings	One to one stakeholders briefings	One to one stakeholders briefings	

5.3: IPR

Electricity North West intends to conform to the Network Innovation Competition default IPR arrangements. All partner contracts will include the standard Network Innovation Competition default IPR clause.

Section 6: Project Readiness

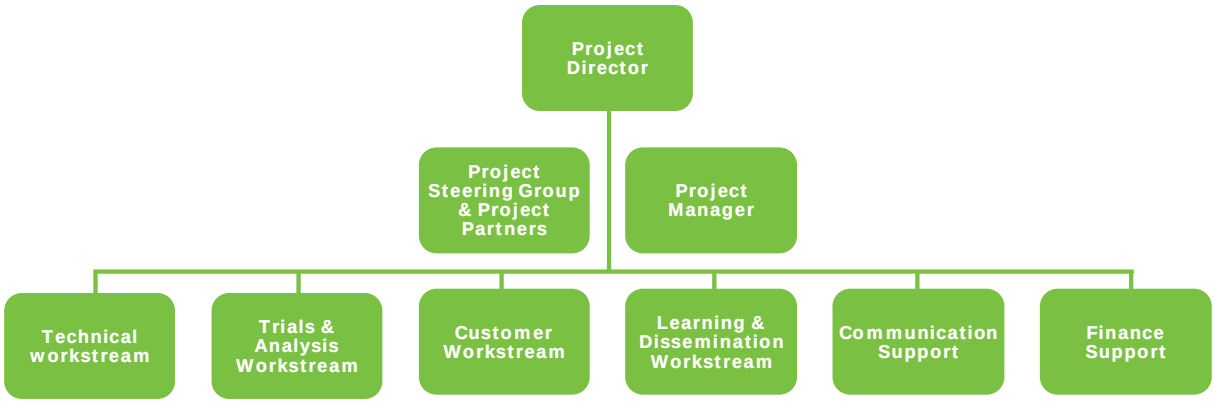
Electricity North West has a proven track record of delivering innovation projects to time and budget. Together with our chosen partners and suppliers we are confident that we can deliver the project learning and benefits.

- Requested level of protection required against cost overruns: 0%
- Requested level of protection against direct benefits: 0%

Electricity North West is confident that, if successful, PS+ will start in a timely manner due to the significant amount of preparatory work which has taken place prior to the full submission. Electricity North West already has dedicated teams set up within the engineering & technical directorate who can build upon past experience from previous successful submissions.

Project management and governance: PS+ will use the programme management and governance approach currently being employed for the delivery of the Smart Street, Respond and Celsius projects. Following the successful closedown of C_2C and CLASS, this proven project governance methodology will ensure that PS+ delivers the defined milestones and project deliverables. Enhancements to the methodology identified in the delivery of previous and ongoing projects can be easily transferred into the PS+ project. The philosophy to be open and collaborative, with the commitment to get it right first time, already seen in our previous project delivery, will be embedded in the PS+ project team. The project management structure is shown below.

Figure 6.1: Project management organogram



Project partners and contractual arrangements: project partners and suppliers are carefully selected, dependent on experience, cost and the organisation's ability to commit skilled resources to deliver PS+ and disseminate the learning to other GB DNOs. The process by which partners are selected is described in Section 4b.

PS+ has established a dedicated consortium and generated work schedules in collaboration with our partners/suppliers that define their roles and responsibilities as well as cost and timing schedules. This will be a key success factor in enabling the project to start in a timely manner and the schedules form the basis of our contractual arrangements with each party. Defined roles and responsibilities and their financial costing and contributions for the provision of services and/or products are included in the full submission workbook (see Appendix L). A key outcome of this approach is that Electricity North West minimises time spent on agreeing contractual agreements and ensures that PS+ can be mobilised very quickly once funding has been granted.

Project costs and direct benefits: the costs and direct benefits have been compiled by a management accountant federated into the bid team. Inputs were generated by our internal and external project partners/suppliers and have been approved through Electricity North West's internal investment appraisal process.

A management accountant, responsible for managing all costs and constructing and delivering the reporting requirements, will be embedded in the project team along with the PMO to manage the budget. Electricity North West runs a robust financial tracking and reporting system in line with its current internal policies and frameworks. The project finances will be held in a separate bank account required by the NIC governance document. This will meet the following requirements:

- Show all transactions relating to (and only to) PS+
- Be capable of supplying a real-time statement (of transactions and current balance) at any time
- Accrue expenditures when a payment is authorised (and subsequently reconciled with the actual bank account)
- Accrue payments from the moment the receipt is advised to the bank (and then subsequently reconciled with the actual bank account)
- Calculate a daily total; and calculate interest on the daily total according to the rules applicable to the bank account within which the funds are actually held

Electricity North West's auditors, Deloitte, will be made aware of its responsibilities should PS+ be awarded NIC funding.

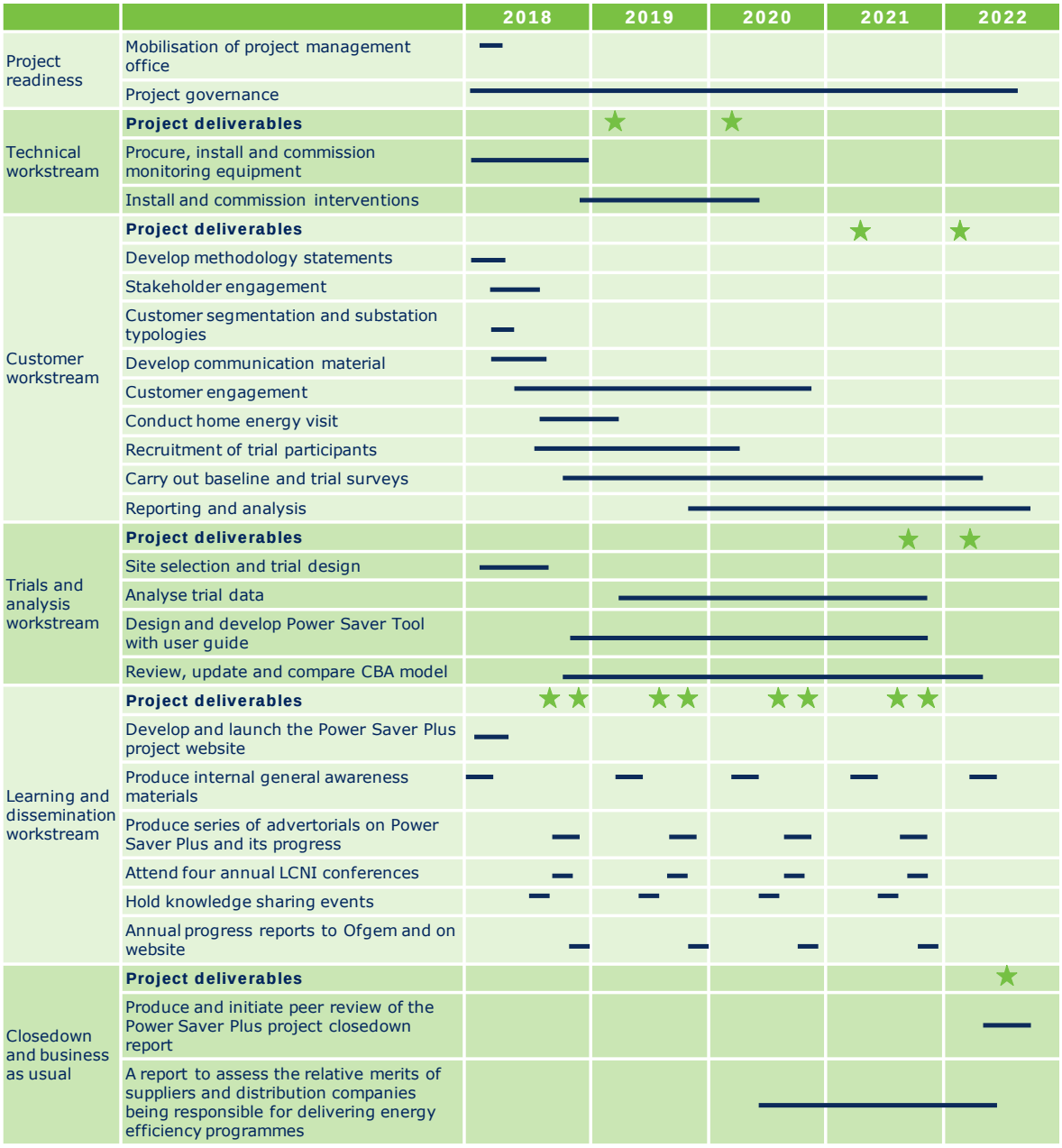
Assurance and sign-off: The assurance activities of the funding request submission are underpinned by the robustness of our bid process. We assured and challenged our bid via a number of means including:

- Developing detailed internal cost models. These include evaluating the project resources required, with proposals from third parties subject to fixed price contracts
- All contributions by partner organisations separately documented and challenged
- All costs and contributions collated and reviewed by the finance team
- Benefits estimates compiled by ourselves and project partner Delta-ee
- Internal audit regime.

Our submission is jointly signed off by three people: our central services manager, Cara Blockley, engineering & technical director, Steve Cox and chief executive officer, Peter Emery.

Project plan: The project plan sets out the approach by workstream and activities that Electricity North West and PS+ project partners will undertake. In addition to the four workstreams, the plan includes mobilisation and closedown phases. A high level overview of the plan is shown below and a more detailed version can be found in Appendix G.

Figure 6.2: High level project plan



Mobilisation: The mobilisation of internal and external teams, as well as the retention of those individuals across the project delivery lifecycle, is crucial to the successful start and continued delivery of the PS+ project. Electricity North West has identified delegate resources to deliver PS+, managed by a full time Electricity North West project manager. The team will also receive significant help from within the wider innovation team. Furthermore the partners have identified resources that will be dedicated to the project.

Technology: The technology workstream will install monitoring equipment before procuring, purchasing and installing the various energy efficiency interventions, based on the results from the in-home energy survey.

Trials and analysis: During the trials and analysis workstream, the project team will finalise the site selection along with the project partners. Once the data has been gathered it will be analysed and the results generated will feed into the Power Saver Tool to share with other DNOs. This tool will be designed, developed, tested and we will provide a user guide. In addition an updated CBA model will be produced to include wider

benefits and also aid the RIIO-ED2 submission. This will include consultation with the wider industry and other stakeholders.

Customer: the customer workstream runs in parallel with the whole project and more detail can be found in Section 8 and Appendix C.

Learning and dissemination: the learning and dissemination workstream will incorporate all dissemination activities and make use of real and virtual media channels to ensure maximum reach.

Closedown: during this phase the monitoring equipment will be removed and decommissioned. The closedown report will be drafted and reviewed by an external body.

The project plan provides a clear roadmap to steer and support the PS+ project delivery team in achieving the relevant milestones and deliverables on time and within budget.

Uptake of low carbon technologies in the trial area

The PS+ scope is designed to deliver learning and develop the outputs without the need for further low carbon or renewable energy uptake on the trial networks. The methodologies to be developed in PS+ can be applied to any distribution network, regardless of the load type, to understand whether new loads can be accommodated.

Risks, mitigation and contingency plans: a key aspect of our project management methodology is the capability to manage risks and issues. PS+ will employ the proven risks and issues process currently in operation in Electricity North West, but modified from our previous experience in the delivery of LCN Fund and NIC projects. The risks and issues model employed considers risks and issues that are business as usual and those specifically related to PS+, all of which will be articulated in a common format.

Appendix H contains a table of risks with mitigation and contingency actions identified prior to the start of the PS+ project. This also shows the format and description of the Electricity North West scoring matrix used to evaluate the identified risk and controlled risk following use of any mitigating action(s). Mitigation and contingency creation and definition form a key part of our risk management strategy. The project management team and project steering group will use this methodology to continually identify and review PS+ risks, their mitigating action(s) and controls to ensure that risks are managed in priority order. When a risk is raised the project management team will be responsible for creating a mitigation action that can be brought into play should the risk be realised. Standard topic areas in the risk identification process include cost monitoring management, particularly considering cost overruns or shortfalls in direct benefits.

The project steering group will also identify the circumstances that may lead to the project being suspended, until such time as sufficient risk mitigation has occurred to enable ongoing management of the risk or issue; or to halt the project and defer further commitment until agreement has been reached with Ofgem on how to proceed.

Section 7: Regulatory Issues

The PS+ trials encompass a range of elements which go beyond the normal role that is expected of a DNO, but we do not anticipate that we would need a specific derogation or exemption granted for the trials to take place. We have also raised some specific areas for consideration should elements of the trials be rolled out into business as usual.

Considerations moving into business as usual

In the PS+ trials, we are trialling the concept of a DNO procuring and deploying energy efficient measures and devices on the customer side of the meter. In the trials, we anticipate that we will issue the devices to customers on a heavily subsidised or free issue basis, as long as the trial participants agree the devices remain in the property to which it was issued during and after the trial.

We have identified that the following areas would need to be considered if the PS+ method proves to be successful and was to be rolled out into business as usual:

- The current Energy Company Obligation (ECO) scheme delivering domestic energy efficiency in the UK would need to be replaced by a DNO-led scheme or be revised to incorporate the provision of energy efficiency interventions by DNOs. Our preference is for a DNO-led scheme replicating the ECO scheme for the delivery of measures, with the Power Saver Tool repurposed with a vulnerable customer focus
- The relationship between the customer and their regional network operator will change through the DNO's transition to a DSO and it is expected that the delivery of energy efficiency to the end users of the network will form a significant stream within this relationship
- The solar PV deployed in the PS+ trials aims to mitigate network losses and constraints, but the treatment of any energy generated by PV on our network will need further consideration, as will potential revenue streams and ownership of the generation assets
- Funding allowances for RIIO-ED2 and future price controls would need to be reviewed to incorporate additional funding to allow the PS+ method to be deployed at scale.

Section 8: Customer Impact

Electricity North West is driven by the vision to be the leading energy delivery business, providing customers with an excellent service through a safe, reliable, affordable and sustainable electricity network.

Tangible customer benefits, derived from reduced consumption will be delivered by deploying a range of energy efficiency interventions across a representative sample of networks and customer demographics. The customer workstream in PS+ will measure customers' attitudes and behaviours and will combine with quantitative data to demonstrate which interventions drive a reduction in household consumption, helping customers to reduce their electricity bills, while delivering benefits for all GB customers from deferred or avoided investment in infrastructure.

The project will demonstrate which energy efficiency interventions, or suite of measures, are most effective in delivering customer and network benefits when applied at scale, across a wide range of networks, serving different customer types. The research will primarily be focused on domestic customers from within the North West region and will include SMEs and micro businesses where they reside in the same area as domestic customers.

The aims of the PS+ customer workstream are:

- To lower customer energy consumption and costs
- To better understand how to engage/target different energy users and customer/ house types with energy efficiency in order to maximise the benefit of energy efficiency to DNO customers
- To quantify the wider societal benefits of energy efficiency.

This learning will be influential in informing the development of the Power Saver Tool, which will be transferable across GB, allowing DNOs and other stakeholders to identify the most appropriate energy efficiency interventions to deploy, to deliver a cost-effective reduction in demand.

Electricity North West will work in collaboration with its project partners, Impact Research, the Energy Saving Trust, Delta-ee and BRE, drawing upon their respective expertise in the built environment, energy efficiency, and customer demographics to select appropriate trial networks. It will then adopt a robust customer strategy to target, engage and retain customers throughout the trial. This approach will provide a cost-effective way to ensure the project benefits from accumulated knowledge across key project partners.

Impact Research and Energy Saving Trust have a deep knowledge and wide range of experience in delivering innovative and effective customer engagement and advice programmes. For example, Ofwat: Price Review 19 (PR19) customer engagement, Scottish Water efficiency trial, Welsh Government fuel poverty programme: NEST, BEIS: National Energy Saving Advice Service (ESAS) and Scottish Government: Home Energy Scotland renewable and energy efficiency specialist advice service (HREESAS). PS+ will engage with a substantial number of customers across the selected trial areas to demonstrate a representative result at scale. The project will have a key focus on planned engagement methods and channels to drive engagement and adoption and ensure customers fully understand the benefits and requirements of participating in the project. To achieve this objective, a number of initiatives are planned including:

- Research into previous and current projects which have involved a strong customer interface to capture and incorporate key learning points
- Gathering information and findings from a wide range of reports such as the Bonfield 'Each Home Counts' review on approaches to energy efficiency

- Involvement of local stakeholders including local authorities, registered social landlords and local community representatives to encourage customer participation
- Collaboration with recognised providers/installers of energy efficiency interventions to give customers confidence in the quality of the installation
- Ensuring that installers use only high quality, appropriately approved and rated equipment, and provide a full after-sales service and warranties.

This section describes the proposed customer engagement and communication strategy, along with the customer research methodology that will be adopted during the trial from recruitment to reporting and analysis. More information can be found in Appendix C.

Figure 8.1: Customer engagement strategy

Area	Description
Customer segmentation and substation typologies	• Existing customer segmentation will underpin analysis of the home energy survey to demonstrate key drivers and variations in behaviour and environmental pressures • A review of secondary data sources, covering energy consumption data, classification of housing types, size, tenure and other demographic profiling • Attention to replicability of the segmentation analysis by other DNOs, favouring standard industry data and nationally available customer profile datasets • Representative networks across the Electricity North West region, including rural and urban configurations
Data and ethics	• The acquisition and use of smart meter and other property-specific or customer data by Electricity North West and its project partners will be subject to a stringent data privacy statement, and the explicit consent of participating customers
Customer impact	• On trial networks • Technology installation at customer premises • Outside trial area
Stakeholder engagement	• Stakeholder deliberative events involving local community groups, charities and housing providers • Events will comprise a mix of information sharing and idea generation, to establish a steering committee of engaged local organisations • Regular updates will be provided on the progress of the trials via two-way communication and consultation mechanisms
Customer engagement and communication	• Methodology • Customer engagement plan • Data privacy statement • Communication material to educate and engage customers • Brand awareness campaign
Recruitment and engagement	• Recruitment process map to document key activities and dates • Recruitment methodology is likely to include community face-to-face events and will be supported by more traditional techniques such as leafleting and mailshots. More direct engagement methods could include door-to-door, phone, digital and social media • Our priority services register (PSR) will be signposted for eligible customers • A central service will be established to support all trial customers, as required, throughout the project
Customer	• Sustaining engagement will be key to the success of this project

Area	Description
retention	and therefore trial participants will be provided with regular updates and/or given energy efficiency advice, dependent upon the particular trial sample • Updates and information will be delivered and available via a number of communication platforms. Face-to-face/community events and/or drop-in clinics will be held to maintain engagement so trial participants can share their experience and obtain advice
Customer surveys	• Eligibility/screening questionnaire • Baseline survey/home energy visit • Survey 2:mid-trial changes in behaviour • Survey 3:end-of-trial • Survey 4:sustainability
Analysis and reporting	• Bring together technical data and customer perception data to assess the effectiveness of the energy reduction initiatives and understand the optimal approach • Customer feedback will be analysed to assess the extent to which the various interventions have achieved success against pre-defined action standards • Interim lessons learned reports will be produced to disseminate the key findings as the project progresses at mid-trial, end-of-trial and post-trial periods

Our aim is to maintain a positive customer experience throughout the duration of PS+. This upholds the Electricity North West core values of putting our customers at the heart of our business.

A central support service will be established allowing customers to raise questions or concerns with the PS+ project team directly. All trial participants will be provided with these details when they opt into the trial. In addition a number of communication channels will be utilised so that customers will find it simple to raise any questions or concerns at a time convenient for them:

Telephone: In addition to the project-specific central support service, customers will be able to contact Electricity North West via its customer contact centre. This enquiry service enables customers to make contact 24/7 on 0800 195 4141.

Written correspondence: The PS+ team can be contacted at the following address: PS+ project team, Technology House, Salford, M6 6AP.

PS+ website: The PS+ website will contain all relevant information including trial areas, customer activities, project literature and project team contact details. Frequently asked questions will be posted and updated regularly. If a customer is unable to find an answer to a specific issue a 'contact us' function will allow them to submit their query so that a member of the project team can respond via the customer's preferred feedback method.

Social media: Electricity North West holds Twitter, Facebook, Linked In and You Tube accounts and can provide updates or responses to customer enquiries via these channels.

The PS+ team will seek to respond to all queries as soon as possible and in all cases, within ten working days.

Feedback received from customers, stakeholders and partners may be used to revise plans throughout the project life in order to continually improve the customer engagement strategy. The PS+ project will share all customer communication materials and findings, and the team will consult with Ofgem in advance of any significant changes from the original approach.

Section 9: Project Deliverables

Ref	Project Deliverable	Dead line	Evidence	NIC Funding Request
1	Comply with knowledge transfer requirements of the Governance Document	End of project	1. Annual project progress reports which comply with the requirements of the Governance Document 2. Completed closedown report which complies with the requirements of the Governance Document 3. Evidence of attendance and participation in the annual conference as described in the Governance Document	N/A
2.	Power Saver Tool	Oct 2018	1. Identify and analyse customer segments (segments will be defined by economic/social/housing class) and produce report to be published on the website (site selection/customer segmentation strategy)	15%
		Dec 2021	2. Report to be produced and published detailing the impacts from the interventions: a) Technology b) Behaviour c) Combined	
		Mar 2022	3. Design, develop and test the tool and publish user guide	
3.	An enhanced CBA model ('Improved Investment Assessment Tool')	Dec 2018	1. Updated Ofgem CBA model, level one of additional benefits included	7%
		Dec 2018	2. Good practice guide supporting the CBA to consider the NPV of alternative types of intervention	
		Sep 2020	3. Updated CBA model, level one and two benefits included. Revised good practice guide supporting the CBA to consider the NPV of alternative types of intervention	
		Jun 2022	4. Gap analysis report, benchmarking CBA against other utility sector models containing findings recommendations for further development where deemed appropriate	
4.	New knowledge of effective techniques in engaging with customers to obtain their buy-in to energy efficiency interventions and attitudes towards access to data	Jun 2022	1. Publish a report detailing the most effective methods of customer engagement and recruitment	20%
		Jun 2022	2. Publish report quantifying the acceptability of DNO-led home energy efficiency interventions	
		Sep 2020	3. Good practice guide on personal data related to PS+ as business as usual	

Ref	Project Deliverable	Dead line	Evidence	NIC Funding Request
5.	Install and commission monitoring equipment. Collate and analyse monitoring data	Feb 2019	1. Report on substation monitoring installs	16%
		Apr 2021	2. Make monitoring data available upon request, create peer review and publish reports detailing analysis and findings	
6.	Install and commission energy efficiency interventions	Sep 2020	Publish list of interventions deployed within the trial areas and price points	17%
7.	Install and commission network-based PV	Jun 2019	1. Feasibility report on sites suitable for network PV installation	7%
		Dec 2021	2. Measure and analyse changes to the average and peak demand at transformer and feeder level	
		Mar 2022	3. Report on the benefits of network based PV	
8.	Install and commission customer side of meter PV	Jun 2019	1. Feasibility report on types suitable for free issue PV including projected benefits and recommendations	8%
		Jul 2020	2. Provide behavioural education material regarding energy efficiency	
		Dec 2021	3. Measure and analyse change in load due to reduction of consumption	
		Mar 2022	4. Report on the network effects of PV deployment on network	
9.	Install, monitor and analyse energy efficient electric heat interventions	Dec 2021	Report outlining site selection, deployment, monitoring, analysis and recommendations for energy efficient heat interventions	10%

Section 10: List of Appendices

Appendix number	Title
A.1	Benefits Tables
A.2	Base Case Method and Solution (Business Case)
B.1	Technical Description
B.2	Site Selection Indicative Methodology
B.3	Trial Size Methodology
C	Customer
D	Review of Forerunner energy efficiency Projects
E	Behaviour Sustainability Report
F	Organogram
G	Project Plan
H	Risks and Issue Register and Contingency Actions
I	Project Partner Details
J	Letters of Support
K	Glossary
L	Full Submission Spreadsheet

Appendix A.1: Benefits Tables

Financial benefits

Figure A.1.1 below shows the financial benefits for the techniques proposed in the PS+ project. Please refer to Figure 2.5 for detailed trial descriptions.

Figure A.1.1: PS+ financial benefits by 2050

Financial benefit (£m) – per individual solution on an NPV basis								
				Benefit (£m)				
Scale	Trial	Method cost (£k)	Base case cost (£m)	2030	2040	2050	Notes	Cross references
Post-trial deployment (individual solutions)	1	0.35	0.223	0.35	0.48	0.57	See below	
	2	0.75	0.223	0.31	0.43	0.50		
	3	0.04	0.223	0.50	0.70	0.82		
	4	0.27	0.223	0.24	0.33	0.39		
	5	0.28	0.223	0.13	0.19	0.23		
	6	21.4	0.223	0.35	0.32	0.28		
	Total	23.09	1.338	1.88	2.45	2.79		

Financial benefit (£m) – scaled up to Electricity North West and GB including NPV effects								
				Benefit (£m)				
Scale	Trial	Method cost (£k)	Base case cost (£m)	2030	2040	2050	Notes	Cross references
Electricity North West scale	1	0.35	0.223	2.29	4.36	5.67	See below	
	2	0.75	0.223	2.02	3.84	5.02		
	3	0.04	0.223	3.30	6.28	8.25		
	4	0.27	0.223	1.56	2.96	3.85		
	5	0.28	0.223	0.24	0.44	0.57		
	6	21.4	0.223	1.58	2.60	3.06		
	Total	23.09	1.338	10.99	20.48	26.42		
GB scale	1	0.35	0.223	30.48	57.89	75.24	See below	
	2	0.75	0.223	26.82	50.94	66.71		
	3	0.04	0.223	43.89	83.36	109.5		
	4	0.27	0.223	20.72	39.37	51.17		
	5	0.28	0.223	3.17	5.79	7.53		
	6	21.4	0.223	20.98	34.53	40.64		
	Total	23.09	1.338	146.06	271.88	350.79		

The general assumptions applied to the calculation of net benefits are as follows:

- All costs are in 2017/2018 prices.
- Method is presented in pounds thousand.
- Base case and benefit are presented in pounds million.
- Method and base case costs are the unit asset and intervention costs for individual deployment within each of the six trials, as described in Appendix A.2.
- The traditional reinforcement cost used in the calculation of the benefits is based on an 800kVA transformer, 1 600Amp 5 way LV board or cabinet and 300mm^2 cross-sectional area conductor. Individual net benefits may vary for smaller or larger assets, yet the use of representative sizes enables a simple quantification of likely typical net benefits.
- Investment for the base case is triggered following forecast load exceeding 100% of the transformer nameplate rating value.
- Deployment of interventions is triggered when forecast load exceeds 100% of the transformer nameplate rating value.
- Interventions are only counted when they can cost effectively reduce consumption to maintain a peak load within asset nameplate rating.
- While transformer rating triggers the PS+ methods, other LV assets are included in the base case costs. See Appendix A.2.
- Net benefits are considered on an NPV basis for six interventions corresponding to the defined base and peak load reductions to model the timing of investment.
- As equipment costs are uncertain over the period from now to 2050, costs are assumed to be constant.
- To represent the net benefit of the PS+ methods to customers, we follow the approach in the Ofgem RIIO-ED1 CBA template v4, in terms of the financing of DNO expenditure, the valuation of losses including their carbon value and social discount rates.

To derive the net benefits, a number of assumptions have been applied to each individual trial. Intervention specific assumptions are outlined in Appendix A.2 while the trial implementation assumptions are as follows:

Trial 1: Retrofit energy efficient appliances in customer premises

- When rolled out across Electricity North West, a blended mix of the interventions will most likely deliver the most cost effective benefits. To account for this, the analysis has applied a deployment factor to each intervention. In the case of more efficient appliances, 20% has been selected. This figure will be informed by the trial and adjusted as appropriate.
- The appliance net benefits achieved through models of the blended mix approach to be tested in Trial 8 have been accounted for in Trial 1 figures within Figure A.1.1.

Trial 2: Retrofit energy efficient electrical heating in customer premises

- The efficient electrical heating deployment factor addresses the fact that only around 7.5% of households across the Electricity North West network are electrically heated at present. Sensitivity analysis was conducted to determine the most economic percentage mix within the identified ceiling for electrical heating. This method applies a 5% deployment factor. This figure will be informed by the trial and adjusted as appropriate.

Trial 3: Retrofit energy efficient lighting in customer premises

- Sensitivity analysis was conducted to determine the most economic percentage mix, taking estimated improvement opportunity into account. The efficient in-home lighting applies a 25% deployment factor. This figure will be informed by the trial and adjusted as appropriate.
- The lighting net benefits achieved through models of the blended mix approach to be tested in Trial 8 have been accounted for in Trial 1 figures within Figure A.1.1.

Trial 4: Energy efficiency behavioural advice delivered to customers

- Sensitivity analysis was conducted to determine the most economic percentage mix, taking estimated improvement opportunity into account. The behavioural advice applies a 30% deployment factor. This figure will be informed by the trial and adjusted as appropriate.
- The behaviour advice net benefits achieved through models of the blended mix approach to be tested in Trial 8 have been accounted for in Trial 1 figures within Figure A.1.1.
- It is assumed that to maintain the benefit of the initial behavioural intervention, an information campaign will be needed every six years to remind and reeducate. This cost has been annuitised and applied from the year the intervention is applied to 2050 where the modelled results end.

Trial 5: Retrofit energy efficient street lighting

- While the benefit is shown in Figure A.1.1, it has not been included in the headline figures presented in Section 3. PS+ aims to test the ability of the DNO influence and incentivise local authorities to adopt LED street lights earlier than planned; thus although there is an achievable benefit across Electricity North West and GB, it is unknown what net benefits can be achieved during the PS+ project.
- It is assumed that on average there are five domestic properties per street lamp.
- Not all street lamps or their location are suitable for the method cost we have defined, resulting in the measure not being economic for those sets of street lights. Additionally, not all local authorities will engage and it may not be cost effective to target smaller organisations with privately owned street lights. To account for this the model has assumed only 40% of all street lights can be targeted.

Trial 6: Retrofit roof-mounted solar PV installations on municipal buildings

- Municipal buildings will include a range of premises including but not limited to libraries, community centres, medical centres and schools. However, to simplify modelling, net benefit calculations are based on school analysis.
- On the Electricity North West network there are circa 580 secondary substations with 'SCH' forming part of their name. The FCH model states 12% of secondary substation networks will require reinforcement before 2050, resulting in 66 school substations.
- As schools and domestic premises have different load profiles and will be impacted by the low carbon transition differently, a 75% safety factor has been applied, leaving 49 requiring reinforcement.
- It is noted that not all schools would be suitable or engage, hence 25% suitability and engagement factor has been applied, resulting in 12 suitable sites. This is based on domestic customer sign-on rates of earlier projects.
- As this method will include a range of municipal buildings as described previously, the number of suitable sites has been extrapolated out to 48.
- Calculations are based on two deployments of the method per annum between 2019 and 2050.
- The trial will test the method on ten municipal buildings to assess the concept, yet it assumes four defer reinforcement by ten years.

Trial 7: Retrofit roof-mounted solar PV installations on substations

- Installation of PV panels on substations is not designed to have a direct network benefit. The trial focuses on offsetting network losses and will put forward recommendations as to how savings could be passed to customers. As a result Trial 7 is not included in Figure A.1.1.

Trial 8: Combined measures (lighting, appliance and behaviour)

- The combined measures trial simply tests the deployment of Trial 1, 3 and 4 methods as a blended mix to assess the most likely wider deployment scenario. The net benefits from each of these methods have been included in the figures outlined for Trial 1, 3 and 4 to improve accuracy.

PS+ scale

To scale down the benefit to PS+, only the substations identified as triggering reinforcement within the trial period have been included. PS+ aims to incorporate these into the trial and target those forecast to exceed asset limits in the years that follow. However, as the project must ensure data gathered stands up to academic rigour, the sites selected must be based on criteria other than network requirements alone (see Appendix B). It is therefore assumed that of the substations included in Trials 1, 2, 3, 4 and 8, only 19 will be deferred within the four years of the PS+ project.

The value has been derived from the FCH model, developed and updated in previous Electricity North West innovation projects, which highlights 54 substations as requiring some form of reinforcement during the period. This is split across seven transformer types and 35 of the constrained sites fall in the first year of the trial phase. Thus to ensure a robust set of trials and an achievable programme, 40% of the identified substations falling in the first year of the trials will be targeted and 50% of those within the proceeding years.

The CBA was rerun for this limited number of substations and the benefits of Trial 1, 2, 3, 4 and 8 interventions recorded. Trials 5 and 6 were analysed through independent CBA models and have been discussed in the assumptions outlined within this appendix.

Electricity North West scale

The CBA conducted is based on the Ofgem RIIO-ED1 CBA template v4 and Electricity North West FCH model. As the latter represents the entire Electricity North West network, the CBA has been constructed around this to increase accuracy and facilitate updates and alterations as required.

Net benefits presented in Figure A.1.1 are therefore taken directly from the PS+ CBA models and are based on the sets of assumptions outlined above and in Appendix A.2.

It should be noted that Trials 1, 2, 3, 4 and 8 are included in a single CBA model. It was decided to create a degree of separation between the in-home domestic methods and those to be applied to other parts of the local distribution network. Trials 5, 6 and 7 have been analysed separately to defend against double counting of apparent benefits.

Great Britain scale

As the underlying models have been built up on Electricity North West-wide adoption of the PS+ methods, the extrapolation across all six DNOs and the 14 licences they own and operate was achieved through use of a single multiplier.

This multiplier is as determined by TNEI as part of the *eta: creating efficient distribution networks* Second Tier LCN Fund project presented in 2013 (now known as Smart Street). TNEI proposed that replication of the method across GB should be determined based on the number of LV circuits it can be practically applied to, using data from the Transform model. While the trigger of the PS+ methods is transformer thermal limits being exceeded, much of the benefit is achieved through reducing LV conductor overlay. The network types modelled during Smart Street were revisited in PS+ to support the development of a robust set of base reinforcement costs (see Appendix A.2); hence the approach taken in Smart Street is still applicable to PS+.

The review of Smart Street identified that using the categorisation of LV circuits in the Transform model 72% of GB LV circuits are eligible. To scale from PS+ to GB is by application of a multiplier of 13.28. These factors will continue to be refined during the delivery of the PS+ project.

Capacity released

Figure A.1.2: PS+ energy savings by 2050

Energy savings (MWh)						
		Benefit				
Scale	Trial	2030	2040	2050	Notes	Cross references
Post-trial deployment (individual solutions)	1	331	487	638	See below	
	2	407	600	785		
	3	435	641	839		
	4	562	828	1083		
	5	25	51	76		
	6	354	857	980		
	Total	2114	3464	4401		

Energy savings (MWh)						
		Benefit				
Scale	Trial	2030	2040	2050	Notes	Cross references
Electricity North West scale	1	2,460	6,654	12,222	See below	
	2	3,031	8,197	15,055		
	3	3,237	8,756	16,081		
	4	4,181	11,307	20,767		
	5	107	439	1,009		
	6	1,767	5,388	10,832		
	Total	14,783	40,741	75,966		
GB scale	1	32,674	88,368	162,303	See below	
	2	40,249	108,854	199,929		
	3	42,993	116,274	213,556		
	4	55,522	150,159	275,792		
	5	1,425	5,833	13,398		
	6	23,466	71,553	143,849		
	Total	196,329	541,041	1,008,827		

The core focus of PS+ is to reduce reinforcement through energy consumption reduction or partially offsetting base demand on municipal buildings. For this reason, Figure A.1.2 presents the modelled energy saving of each method in MWh. The assumptions and

scaling methodology upon which these results are based are as discussed in the net benefits section. The savings are the sum of the reduced emissions associated with losses, more efficient in-home devices and photovoltaic generation offset on municipal buildings. Appendix A.2 presents the individual device saving assumptions.

Carbon benefits

Figure A.1.3: PS+ carbon savings by 2050

Carbon savings (tCO2)						
		Benefit				
Scale	Trial	2030	2040	2050	Notes	Cross references
Post-trial deployment (individual solutions)	1	122	157	169	See below	
	2	151	194	208		
	3	161	207	222		
	4	208	267	287		
	5	10	16	17		
	6	127	210	235		
	Total	779	1051	1138		

Carbon savings (tCO2)						
		Benefit				
Scale	Trial	2030	2040	2050	Notes	Cross references
Electricity North West scale	1	862	1,782	2,197	See below	
	2	1,062	2,195	2,707		
	3	1,135	2,345	2,891		
	4	1,466	3,028	3,734		
	5	36	106	147		
	6	627	1,402	1,790		
	Total	5188	10,858	13,466		
GB scale	1	11,454	23,666	29,179	See below	
	2	14,109	29,152	35,943		
	3	15,071	31,139	38,393		
	4	19,463	40,214	49,582		
	5	480	1,403	1,946		
	6	8,327	18,619	23,771		
	Total	68,904	144,193	178,814		

The carbon savings are based upon the MWh savings outlined in Figure A.1.2. The conversion is achieved using the Electricity GHG conversion factor presented for each year in the Ofgem RIIO-ED1 CBA template v4 which are themselves taken from Defra's 2012 GHG conversion factors for company reporting guidelines.

The report provides a tonnes per MWh factor for 2012 and predicts a factor for all proceeding years up to 2050. The figure reduces year-on-year as the carbon intensity of electricity decreases. In the first year of the project the factor is 0.474, decreasing to 0.30 by 2030 and 0.01 by 2050.

The total GB savings have been extrapolated from Electricity North West wide figures. This has been based upon previous work conducted by TNEI Services Limited for the Smart Street project, which analysed the replicablity of PS+ based on the LV network types within the Electricity North West licence area.

It should be noted that while PS+ encourages the decommissioning of inefficient appliances, any negative carbon impact is offset by the carbon associated with the network reinforcement base case.

Appendix A.2: Method and Base Case Methodologies

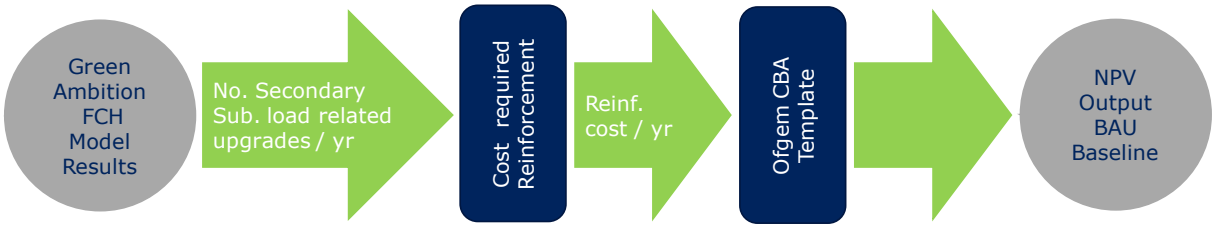
Financial analysis of the PS+ methods and traditional distribution network reinforcement showed that PS+ provides significant net benefits and customer savings while delivering an overall reduction in domestic energy consumption.

Base case

Once a distribution asset becomes thermally constrained, the most common method currently in use is to replace it with a higher rated asset. This procedure was used as the base case on which to test the economic viability of the PS+ methods.

The assessment procedure was developed from the Ofgem RIIO-ED1 CBA template v4 and FCH model. The scenario selected was *Green Ambition* which is perceived to fall between the *Consumer Power* and *Two Degrees* scenarios presented in National Grid's Future Energy Scenarios document (July 2017). *Green Ambition* included a relatively high level of energy saving which this project is designed to trial. Therefore, to enable the benefits of encouraging early adoption of high energy efficiency interventions, energy savings reductions were made to the base FCH scenario (see Figure A.2.3).

Figure A.2.1: Base case methodology flow chart



The level of reinforcement required varies widely depending on the network configuration, installed asset ratings and distribution of the load growth. One scenario may only need the replacement of the distribution transformer itself. At the other end of the scale, an additional distribution substation could be installed as close as possible to the centre of the load, and the load is split between the existing and new substations.

Only considering past expenditure would deliver inaccurate net benefits as the cost associated with future reinforcement of the low voltage network is predicted to rise. As we electrify heat and transport, the demand on the low voltage network will rise, triggering reinforcement of static assets within the secondary substation alongside increasing replacement of linear assets. While the increasing cost is known, quantifying the expenditure on a per substation basis necessitates modelling of representative networks.

Three networks modelled as part of the Smart Street project were used as the foundations for the analysis. Denton East, Hindley Green and Wigton have all been previously studied in the power systems analysis platform IPSA2 and combined are believed to represent the vast majority of the Electricity North West low voltage network. These models were run with heat pumps (2.93kW @ 0.95 p.f.) and electric vehicle charging points (7kW @ 0.98 p.f.) applied in percentage increments (of the domestic customers connected) to determine which assets exceed their ratings and at what saturation point. To fully understand the impact of each low carbon technology, heat pumps and electric vehicle charging points were applied separately in addition to a combined scenario. The domestic customer after diversity maximum demand (ADMD) was set as per Smart Street; 0.2kW minimum to 1.2kW maximum.

The reinforcement triggered within the IPSA2 based models was collated for each asset type and reviewed alongside quantities of installed static and linear assets. The processed datasets were then scaled down to create a substation average. This method was refined and in later iterations scaled down to form weightings against defined classes of reinforcement intervention.

All item values are based on cost estimates within the 2017/18 framework agreements.

Figure A.2.2: Reinforcement options and weightings

Intervention	Item	Total	Weighting
LVA	Change distribution transformer	[redacted]	15%
LVB	Replace LV board (5 or 7 way)	[redacted]	25%
	LV cable (0.6km)		
	Change distribution transformer		
LVC	Change distribution transformer	[redacted]	18%
	Replace LV board (5 or 7 way)		
	LV cable (1.2km)		
	Link box		
LVD	RMU	[redacted]	27%
	Change distribution transformer		
	Replace LV board (5 or 7 Way)		
	LV cable (2km)		
	Link box		
LVE	RMU	[redacted]	15%
	Change distribution transformer		
	Replace LV board (5 or 7 way)		
	HV cable (2km)		
	LV cable (3km)		
	Link box		

Application of the derived weightings results in a reinforcement value of £233 171. This was defined as *medium reinforcement* and all the net benefit figures stated in the benefits tables use this figure as the average cost of the base case solution.

Reinforcement intervention LVC was selected to represent the lowest average reinforcement cost. LVD was selected to represent the highest average reinforcement cost. All references to *low reinforcement* and *high reinforcement* within Section 3 use £176 944 and £256 472 respectively as the cost of the base case solution.

The cost benefit analysis was undertaken by project partners Delta-ee to help provide an independent set of results. Utilising the reinforcement cost analysis and FCH output, Delta-ee constructed the base case model through the steps presented in Figure A.2.3. Their assumptions are included alongside each procedure.

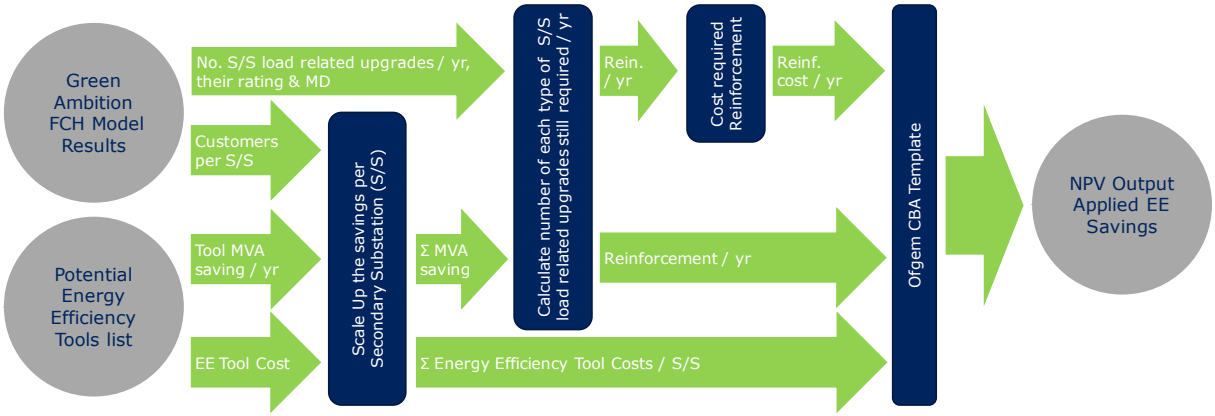
Figure A.2.3: Base case modelling procedure

Step	Procedure	Assumptions
1	Personalise the Ofgem CBA template to facilitate integration of external datasets	No errors in the official base template
2	Import data from the FCH model into the Ofgem CBA template and determine principal components	
3	Extract Green Ambition load growth data for all secondary substations per transformer type on Electricity North West's network	The Green Ambition dataset requires no further validation or review
4	Using FCH substation load data in 2015, 2022, 2030 and 2050, extrapolate for individual years up to 2050	Load growth is linear from: 2015 - 2022; 2023 - 2030; 2031 - 2050
5	Calculate the number overloaded substations per transformer type each year between 2017 and 2050	Once a substation reaches 100% of its nameplate rating, some form of reinforcement is triggered
		Any substation overloaded before 2018 is ignored in the analysis
6	Based on the number of overloaded substations calculated, calculate the number of newly overloaded substations in each year	
7	Remove the reduction in load growth due the energy efficiency that is assumed by Electricity North West in the Green Ambition scenario	Remove 6.5% of 2015 efficiency for each substation to the years 2016 - 2023 Remove 13% of 2015 efficiency for each substation to the years 2023 - 2050
8	Rerun steps five and six to identify the impact the reduced energy efficiency has on the number of substations requiring reinforcement	
9	Apply the reinforcement cost to all substations identified as triggering reinforcement in each year	Medium reinforcement cost is the predicted average cost of the traditional reinforcement required
10	Adjust the net present value tables on the base case tab to communicate values in 2030, 2040 and 2050	The same process is conducted for method to provide correct comparison
11	Run the CBA model developed for the base case solution	All financial figures recorded in £ million

Method

The methods were each assessed against the base case within the Ofgem RIIO-ED1 CBA template v4. Appliances, heating, lighting and behaviour were all treated within the same document as in-home energy saving interventions. Street lighting, municipal and substation photovoltaic panels were all treated independently to provide a degree of separation and simplify the assessment process.

Figure A.2.4: Method case methodology flow chart



Generation of the method models followed the high level process presented through the flow chart in Figure A.2.4. The FCH data is as described for the base case and the potential energy efficiency tools list took inspiration from a number of sources, initially including a wide range of devices from a simple timer to embedded home energy management systems. This list was then refined through the process, resulting in the measures Power Saver Plus will trial.

Delta-ee constructed the method model through the steps presented in Figure A.2.5. Their assumptions are included alongside each procedure.

Figure A.2.5: Method case modelling procedure

Step	Procedure	Assumptions
1	Apply diversified peak load reduction of the energy efficiency interventions at the household level to each substation	This calculation varies for each device. See Intervention Assumptions below
2	For each substation type define the average number of MPANS connected to the substation	Based on analysis performed by Delta-ee of the 'asset data' Excel files from Electricity North West. Defined the split as 93.57% residential and 6.43% commercial
3	Define the mix of energy efficiency interventions to be applied to the properties on each of the substation types	As Figure 3.6 in Section 3
		40% of homes on a substation are treated with energy efficiency interventions to account for uptake following wider rollout
4	Calculate peak load reduction from each energy efficiency intervention at the household level	Assume the same 'average' home for each energy efficiency intervention
5	Diversify the peak load reduction value to reflect the diversified operation of appliances across the population	See Intervention Assumptions below.
6	Calculate the peak load reduction at the substation level from deploying energy efficiency interventions	Using the number of homes per substation, mix of energy efficiency interventions per substation and diversified peak load reduction values from previous steps.

Step	Procedure	Assumptions
7	Subtract the peak load reduction at the substation level from the previously identified overloaded assets out to 2050	
8	Calculate the number of overloaded substations in each year once energy efficiency has been deployed across Electricity North West's network	The energy efficiency interventions have a defined asset life. Assumed customers would replace with equally as efficient in 15 years
9	Identify the timing and capacity of an overloaded substation where energy efficiency is deployed to account for deferrals within the 2019 to 2050 timeframe	Once a substation reaches 100% of its rating, it requires some form of reinforcement. Celsius methods have been accounted for in the calculation of the network reinforcement costs
10	Remove the benefit calculated from any year before 2019	Energy efficiency deployment will only start in 2019 so any overloaded substation before this time would have to be treated with the base case
12	Apply the reinforcement cost to all substations identified as triggering reinforcement each year (as base case)	Medium reinforcement cost is the predicted average cost of the traditional reinforcement required
13	Adjust the net present value tables on the base case tab to communicate values in 2030, 2040 and 2050	The same process is conducted for base to provide correct comparison
14	Run the CBA model developed for the method solution	All financial figures recorded in £ million
15	Calculate the net benefit of energy efficiency intervention deployment versus the business as usual base case	
16	Following the same base methodology, construct separate models for street lights, municipal PV and substation PV	See Appendix A.1 and the Intervention Assumptions below

Intervention assumptions

To calculate energy consumption saved by each of the energy saving tools, research was conducted to define a kWh figure or range. In the cases where no quality reference source was identified, the following equation was used to derive the benefit.

Equation A.2.1: Determines benefit of energy saving device

$$Tool\ benefit\ =\ (Watt\ saving) \times (h/day) \times (£/kWh) \times \left(\frac{Days\ in\ year}{1000}\right)$$

- *'£/kWh'* - 14.37p/KWh customer electricity unit price. This value is the average peak unit price in 2017, as calculated by the Energy Savings Trust.

The savings achievable alongside all other core device-specific assumptions for the methods on trial are as follows:

Appliances

- Average annual energy reduction of 133kWh
  - Calculations based upon manufacturer quoted figures
  - Five different appliances are to be trialled as specified in Figure 3.6
  - Based on the average reduction between A+++ and the most commonly owned
- Peak load reduction of 0.148kW
  - Assume utilisation is eight hours, 0.74 hours and 0.85 hours per day for fridge /freezers, washing machines/tumble dryers and dishwashers respectively
  - Using the average reduction between A+++ and the most commonly owned and utilisation the peak load is calculated at 0.212kW
  - Assume 70% diversity factor, reducing to 0.148kWp
- Appliances are cost-estimated at £345 based on online supplier costs
  - Includes install of the new appliance and decommissioning of item
  - This is based on 50% of appliances offered being fully funded by the DNO, 25% achieved through a supply of the appliance only and the remainder driven by an incentive of £150 towards a new appliance.

Heating

- Average annual energy reduction of 983kWh
  - Calculations based upon Dimplex quoted figures available on their website
  - Annual energy reduction as quoted by Dimplex for the Quantum range versus traditional electric heaters
  - Utilisation estimated at seven hours across the winter period
- Peak load reduction of 0.385kW
  - Assume the local thermal constraint is during the winter peak
  - kWh / days in year / h/day = 0.385kW
- Heating is cost estimated at £869 based on costs stated by Dimplex
  - Includes install of the new heating system and decommissioning of old system
  - Includes the cost of removing asbestos filled heaters.

Lighting

- Average annual energy reduction of 150kWh
  - Assumes halogen bulbs (40W) are replaced with LED lights (6W)
  - 54W reduction in load from each individual bulb replaced
  - Utilisation estimated at four hours when averaged across the year. This has been calculated from the average daylight hours in the North West of England for each of the four seasons
  - 48.2kWh annually per bulb, thus 481kWh for ten replacements
  - To account for household variation only the full benefit from three of the ten replacements has been used, providing a circa 150kWh saving
- Peak load reduction of 0.27kW
  - Assume only 25% of the lights contributing to the 150kWh reduction are on during an evening peak
  - kWh / days in year / h/day x 25% = 0.27kW
- Lighting is cost estimated at £40 based on online bulk purchasing figures
  - £4 for an individual LED bulb
  - £35 for a LED panel comprising of five LED bulbs
- Analysis is based on the average deployment of ten individual LED bulbs or one LED panel and an LED bulb
- Cash benefit to the customer through longer lifespan. 8 000h op. life span not included (1 000 – 2 000h of traditional incandescent).

Behaviour

- Average annual energy reduction of 176kWh
  - Power Saver Challenge found 5.8% reduction of annual domestic consumption
  - Annual electrical consumption of 3800kWh for gas heated home selected[8]
  - An eco-kettle can help achieve this through assisting the application of behavioural messaging and directly saving 40kWh on average[9]
- Peak load reduction of 0.074kW as derived by Delta-ee. Little saving at peak time included for in the model which is a pessimistic approach
- Annual ongoing cost of £35 from deployment. Assumes that behaviour benefit is only maintained if there is re-engagement once every six years, providing £210 per customer which would facilitate face-to-face contact
- Initial cost to deploy the behavioural campaign (face-to-face and all other media) is taken to be £270
  - £200 for the campaign as outlined by our partner Impact
  - £70 for an eco-kettle or equivalent device/set of devices.

Street lighting

- Average annual energy reduction of 130kWh
  - Sources state a range of savings from 130kWh to 250kWh[10]
- Peak load reduction of 0.27kW
  - Assuming a change saves 130kWh annually, and that the LED light operates for 16 hours, nine hours and five hours for a third of the year
  - Only 70% taken to account for long utilisation period during the winter
- Street lighting is cost estimated at £270 (installed) based on council figures.

Municipal photovoltaic

- PV installation installed has an average of peak output of 18.75kW
- Generation factor of 850kWh/kWp
  - Delta-ee assumption matching solar map from Photon Energy
  - Assumes optimum pitch, south orientation, and very little overshading
- PV is cost estimated at £23 800 (installed) based on DECC figures from 2015
- 15-year lifetime for inverters (30 for the panels themselves)
- No maintenance costs included as these would be the responsibility of the owner
- Annual reduction in PV output of 1%.

Substation photovoltaic

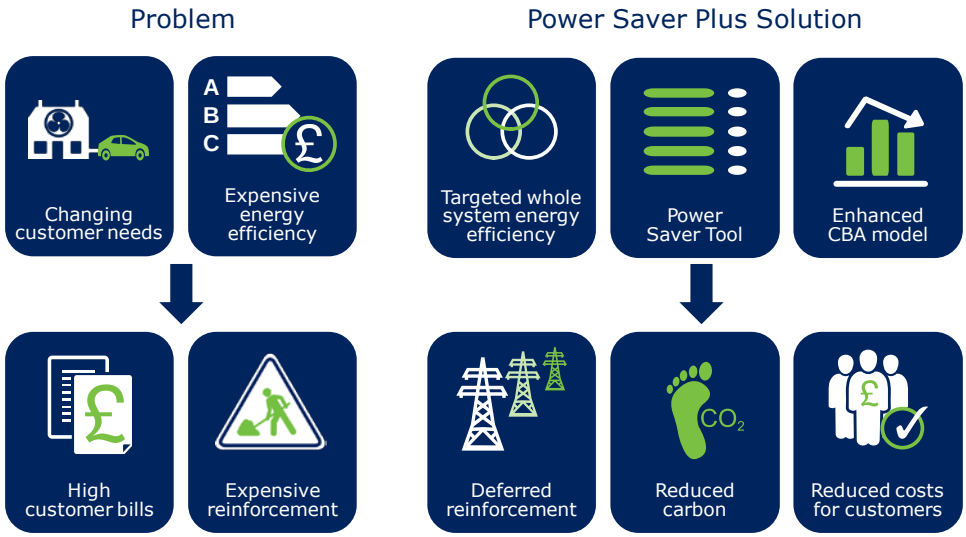
- PV installation installed has an average of peak output of 4kW
- Generation factor of 850kWh/kWp
  - Delta-ee assumption matching solar map from Photon Energy
  - Assumes optimum pitch, south orientation, and very little overshading
- PV is cost-estimated at £2 600 (installed) based on DECC figures from 2015
  - Assumes DNO can install at a lower cost during planned maintenance
- 15-year lifetime for inverters (30 for the panels themselves)
- £2/kWp/yr DNO-led maintenance costs included
- Annual reduction in PV output of 1%.

[8] https://www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics
[9] http://www.sciencedirect.com/science/article/pii/S0306261916303579
[10] http://www.greeninvestmentbank.com/media/5243/gib-market-report-low-energy-streetlighting-feb-2014-final.pdf

Appendix B.1: Technical Description

PS+ aims to explore the role of a DNO in the deployment of energy efficiency to its customers and to prove that it can deliver the UK's obligations under the Paris agreement more cost effectively than energy retail suppliers.

Figure B.1.1: PS+ project overview



Background

The UK government approach to delivering energy efficiency differs from the way it is delivered in most of mainland Europe, with most countries placing the obligation upon network operators rather than suppliers.

The UK government introduced its first obligation on energy suppliers to deliver energy efficiency in 1994, known as the Energy Efficiency Standards of Performance programme (EESoP 1). Although the scope of the policy has changed over time, including the technologies and customers that are eligible for support under the mechanism, the high-level structure of the obligation has remained constant over time. The current Energy Company Obligation (ECO) remains in essence an obligation on energy suppliers to deliver reductions in energy consumption (and thereby carbon emissions) by installing energy saving devices or insulation in eligible customers' homes. At its launch in 2013, the ECO was supported by an innovative financial product called the Green Deal, which allowed customers to borrow money against future energy savings and to repay the outstanding balance through their energy bills. The Green Deal failed to stimulate new demand for eligible insulation projects and was abandoned, while the government watered down the ECO programme to allow for a slower delivery timetable.

During the scoping phase of the PS+ trials we reached out to a number of energy suppliers and engaged with a 'big six' energy supplier and another, more recent entrant to the market. We found it challenging to gain insight from delivery of their ECO obligations, but had some high level interaction and conducted some wider research.

In practice, the ECO programme does not require suppliers to deliver the energy efficiency savings themselves and many outsource their obligation to third parties. Obligated parties must surrender certificates under the component programmes of the ECO demonstrating the necessary carbon savings to Ofgem. These certificates must be verified by Ofgem and are tradable between suppliers. Under both the ECO and its predecessor programmes, energy suppliers have adopted a variety of business models, including developing in-house teams to identify sites for refurbishments, adopting bilateral contracts with specialist providers of insulation services (such as Carillion) and/or buying through the ECO brokerage system (an auction model which suppliers tend not to use for most of their obligated volume).

The philosophy behind allocating the responsibility to suppliers is similar to that behind the design of the smart metering programme, which is delivered by suppliers in GB and largely by distribution companies in mainland Europe. It is argued that energy supply companies have existing relationships with end-users and information about their energy needs, but unlike smart metering, suppliers' profits are linked to the number of kWh shipped and thus ECO conflicts with their main business drivers.

Because the value of deploying energy efficiency at customer level cannot be recognised and there is no method of calculating the return on this investment, shareholders would not speculatively fund such measures. We are therefore proposing that this trial be undertaken with the support of the NIC.

Within the trial there are some challenges to overcome with regard to ownership and liability for the devices deployed. We will incorporate within the trial an agreement between Electricity North West and the trial participants which assigns the relevant devices to the customer on the basis that it remains in the property to which it was issued and addresses liability and ownership of the devices during and after the trial.

The measures selected

It is anticipated that if the ECO or equivalent obligation was passed over to DNOs or became a shared obligation, then the list of applicable measures would be expanded to include any proven energy and carbon reducing technology. However, for the purposes of the PS+ trials we have taken an approach to select proven technologies that can deliver a demonstrable saving to customers and the network, can be deployed at customer level with the minimum of disruption and are acceptable commodity items with enough longevity to deliver a sustained effect. This has enabled us to keep costs in the trial to a minimum level, and indeed we are able to deliver the project at an overall cost of £8.187m, which is £3.313m less than that projected in the ISP. This is in part due to the contribution of our project partners but also from ensuring that our trial was appropriately sized to give a robust trial sample giving results applicable for other UK DNOs, but without incurring unnecessary cost.

The groups of measures were selected to deliver the maximum impact from the trial. Because two thirds of household electricity consumption is attributed to appliances and lighting, we selected these as two of the trial measures. We identified that within our region although electric heating only represents a small proportion of our network, the majority of fuel poverty occurs in electrically heated homes, and therefore we included a small heating trial as one of the measures deployed. Under the Electricity North West forerunner project Power Saver Challenge, we identified that behavioural change can deliver a significant measurable network impact and we commissioned a short study to demonstrate that this intervention when delivered correctly can be measured over a period of up to six years (see Appendix E). Our final customer intervention is a mix of the above measures; we anticipate delivering a small trial with behavioural advice and support, an appliance and LED lighting, to measure if there is a multiplied effect in the combination of these measures.

The solar PV trials complement the customer interventions as they demonstrate a further alternative stream for an energy efficient network, and further support by delivering low carbon generation to alleviate network constraint. The PV deployed on municipal buildings will be appropriately scoped so that it meets the needs of its host building and can lessen the overall demand on the network that the building represents when in use. The PV which will be deployed on our substations is a small low cost supplementary source of load mitigation, sized to reduce losses within the substation without causing any unintended negative network effects.

Method	Energy efficiency interventions
Trial 1	Retrofit energy efficient appliances in customer premises
Trial 2	Retrofit energy efficient electrical heating in customer premises

Method	Energy efficiency interventions
Trial 3	Retrofit energy efficient lighting in customer premises
Trial 4	Energy efficiency behavioural advice delivered to customers
Trial 5	Retrofit energy efficient street lighting
Trial 6	Retrofit roof-mounted solar PV installations on municipal buildings
Trial 7	Retrofit roof-mounted solar PV installations on substations
Trial 8	Combined measures (lighting, appliance and behaviour)

Trial 1: Appliances

Under the appliances trial we aim to identify older inefficient appliances as part of the customer energy survey and replace them with more efficient A to A++ rated appliances. We have divided the appliances trial into specific streams per appliance, with a minimum number of customers per appliance in the trial. The categories and appliances trialled will be washing machines, dishwashers, tumble driers, refrigerators and freezers. The appliances will be trialled in isolation per feeder or substation, so that the measurable network impact can be identified specific to the appliance and the appropriate data fed back into the Power Saver Tool. The output will also measure customer attitudes towards appliance deployment by a DNO to feed into the knowledge project output.

Trial 2: Heating trial

One of the PS+ trials will explore the network impact resulting from the deployment of modern high efficiency storage heaters to replace older, inefficient storage heaters. This trial stream differs from the others within the project, in that the deployment of this measure in customers' homes has a direct impact on the comfort and wellbeing of the occupants. Because of this sensitivity, we will treat the heat trial differently to the other trial streams, with more monitoring and a smaller trial sample to ensure we are able to give this trial due attention over a manageable number of recruits.

Storage heaters are commonly found in multi-occupancy or high rise buildings and homes that are not connected to the gas grid. Because of the prevalence of private rented and social housing in this type of building, coupled with the relatively high cost to buy storage heaters and their lifespan of 20-30 years, we anticipate that there will be a significant number of older inefficient storage heaters on our network.

The site selection process will vary slightly from the other trials primarily because the types of properties that are electrically heated make up a much smaller proportion of our overall network and there is a higher prevalence of electric heating among a smaller group of housing archetypes. Identified appropriate sites will be assessed for their suitability and the final selected sites will be agreed before recruitment begins. For the purposes of the trial we will focus on multi-occupancy buildings with electric storage heating, with a further focus on those classed as 'difficult to treat' by other alternative forms of heating such as heat pumps. This is to give the maximum aggregated measurable network impact and to make our trial representative of the types of electrically heated building commonly found on our network. Previous research shows a correlation between areas of fuel poverty and urban multi-occupancy electrically heated buildings, so by addressing this archetype we also have the potential to deliver a significant customer benefit.

When the trial participants have been recruited, we will use the Salford University Energy House[11] as a tool to drive engagement with the trial. A temporary installation of the proposed technology will be set up at the University of Salford to allow identified

[11] http://www.salford.ac.uk/research/best/research-groups/applied-buildings-and-energy/accordion/energy-house

individuals to see the technology and have an opportunity to ask questions and a number of resident champions within the trial will be selected. There will be surveys carried out with the recruits before and after deployment of the measures, with specific questions included under this trial to measure attitudes towards thermal comfort and how customers manage the heating within their premises.

The trial will deploy in-home monitoring of electricity usage and demand, plus simple thermal monitoring in sleeping and living spaces to measure the correlation between time of usage and thermal conditions pre-and post intervention. Usability and control surveys will be carried out for each property, specific to participants within the heat trial. This will assess how easy it is for individuals to manage their comfort and provide qualitative data to go alongside the measured changes in electricity usage and temperature. This data will be collated and summarised to inform the Power Saver Tool and the knowledge summarised in the customer engagement output.

The learning from this trial will be coupled with the data from the other trials to give a complete picture of how to treat electrical heating energy efficiency, what the potential boundaries are and the other key considerations from a network and customer perspective. The data and outputs from this trial will be summarised into a report of findings and recommendations and will be fed into the knowledge and dissemination stream and the Power Saver Tool.

Trial 3: Lighting

The prevalence of low energy fluorescent lighting has increased dramatically in recent years, with traditional filament bulbs becoming the minority in most homes and businesses. While we recognise that this has had an impact upon energy demand from lighting, we aim to deploy and measure the impact of more efficient LED lighting alternatives in our customers' properties. Because the benefits of LED lighting are known at a micro level, under this trial we will deploy high efficiency LED bulbs as a single measure concentrated around a single or multiple substations to demonstrate a representative sample. This will enable us to measure the impact of a localised environment heavily populated with this new technology and feed this into the Power Saver Tool.

Trial 4: Behaviour

In the past a range of trials have demonstrated that energy efficiency behavioural interventions can have a significant and cost-effective impact on energy usage. We have also carried out background research through our Power Saver Challenge project and desktop studies. It has been demonstrated that this intervention can have a lasting impact when delivered effectively. PS+ will take behavioural change a stage further than any previous project, using the learning from forerunner trials to deliver this intervention at scale across a representative sample of our network. The learning from this trial combined with the Power Saver Tool will demonstrate and provide a framework by which other DNOs can cost-effectively take a similar approach to deliver the optimum network and customer benefit in their region.

Trial 5: Street lighting

There are two primary aims of the street lighting trial within PS+. The first aim is to test the regional lighting authorities' attitudes towards DNO-subsidised LED street lighting; the second is to test the price sensitivity of this incentive in influencing local authorities to replace inefficient street lights with LED equivalents that they had not already planned to replace. This accelerates the progress of energy efficiency and takes a whole system approach to deploying efficiency improvements. We will measure the aggregated effect of deploying a concentration of LED street lights on a single substation and this data and learning will be disseminated and fed into the Power Saver Tool.

Trial 6: PV on municipal buildings

To further mitigate network constraints we will explore the deployment of solar PV installations on a free issue or significantly subsidised basis on municipal buildings and/or private buildings to offset network demand, reduce losses and reduce carbon.

The solar PV measures will be deployed using a separate site selection methodology, focused on reduction in demand on constrained networks and reduced losses on distribution substations. The solar PV trials complement the customer interventions as they demonstrate a further alternative stream for an energy efficient network, and further support by delivering low carbon generation to alleviate network constraint. The PV deployed on municipal buildings will be appropriately scoped so that it meets the needs of its host building and can lessen the overall demand on the network that the building represents when in use.

Trial 7: PV on substations

We will explore the feasibility of deploying PV on our substation sites to reduce losses. Feasibility studies will be carried out and sites identified where PV can be used to deliver benefits, (predominantly summer-peaking networks) and where the installation does not cause any unintended detrimental effects to the local network.

The solar PV measures will be deployed using a separate site selection methodology, focused on reduction in demand on constrained networks and reduced losses on distribution substations. The PV deployed on our substations is a small low cost supplementary source of load mitigation, sized to reduce losses within the substation without causing any detrimental network effects.

Trial 8: Combined measures

This trial has been selected to deliver a combined set of the above mentioned interventions across a smaller sample size, to measure the combined effects at network level. Delivering this trial at scale will provide learning to demonstrate if a multiplier effect occurs at network level when a suite of measures is deployed, and whether this multiplied effect is greater than the sum (and cost) of its parts. The learning from this trial will feed into the Power Saver Tool and the evidence gathered will further inform DNO's decision-making when choosing which measures to deploy and where.

Monitoring

Monitoring will be carried out at substation level only for all trials except the heating trial, which will use small unobtrusive in-home energy monitoring. In each of the trials there will be one intervention deployed per feeder or substation in all but the 'combined measures' trial to ensure that we measure the specific improvement related to the single measure deployed in that area of our network.

As already described, due to the sensitive nature of the heating trial, in-home monitoring is required to benchmark energy usage against the thermal measurements carried out under this trial. The in-home monitoring devices used in the heating trial will store data internally and this data will be collected physically by connecting a memory stick or similar to the device to draw the data down for analysis. This method avoids the cost of SIM card based wireless transfer of data, overcomes potential loss of data due to connectivity issues, and overcomes potential customer sensitivity over data security relating to wireless transfer of data. All data collected from both customer and substation level monitoring will be securely stored in accordance with the data assurance document created for the trials.

We have identified multiple low cost monitoring solutions which meet the requirements of PS+ and we will run a procurement process to identify the most suitable provider. Feeder level monitoring using Rogowsky coils can be deployed while circuits are live, avoiding customer interruptions. We anticipate that the monitoring will take half-hourly readings as a minimum and will poll data to a secure cloud-based platform via an SMS data link. Where mobile network coverage is not available, data will be accessed manually.

Appendix B.2: Site Selection Indicative Methodology

This appendix describes the proposed methodology for the PS+ trials. The methodology has been developed to allow the selection of representative samples covering substations, building stock, types of tenure, socio-economic groups, location and fuel. The aim is to ensure that the trial population will be representative of the majority of GB.

The PS+ trial will be conducted on a large population of distribution network assets. Therefore, site selection will be informed by a desktop data collection exercise to establish the criteria shown in Figure B.2.1.

Figure B.2.1: Site selection criteria

Constrained substations

Using current planning methods we will create a representative list of distribution substations likely to be constrained within the trial period.

Building stock – the size and age of properties

Using industry standard archetypes, the site selection of building stock will include size; small or large (equivalent to flat or house distinction) and age: pre 1920, 1920-1980 and post 1980.

Tenure

It is proposed to include all types of tenure in the trial; the most common forms of tenure are home-ownership (including homes owned outright and mortgaged) and rented (including social rented housing and private rented housing).

Socio-economic group

The profile of customers who take part in the trial and surveys will be matched to ACORN, a powerful consumer classification that segments the UK population by demographics, social factors, population and consumer behaviour. Also existing customer segmentations such as GreenAware (incorporating environmentally relevant behaviours, attitudes and carbon footprint) will underpin analysis of the home energy survey to demonstrate key drivers and regional variations in behaviour.

Geographic and demographic

To ensure findings are nationally applicable, we will utilise a minimum of three trial areas of different geographic and demographic makeup. These could include a rural area, an urban area with a high proportion of fuel poor customers (for example inner city housing estate) and an affluent urban area (such as a suburb).

Fuel – electric or gas heated properties

The site selection process will vary slightly from the other trials primarily because the types of properties that are electrically heated make up a much smaller proportion of our

overall network and there is a higher prevalence of electric heating among a smaller group of housing archetypes. Identified appropriate sites will be assessed for their suitability and the final selected sites will be agreed before recruitment begins. For the purposes of the trial we will focus on multi-occupancy buildings with electric storage heating, with a further focus on those classed as 'difficult to treat' by other alternative forms of heating such as heat pumps. This is to give the maximum aggregated measurable network impact and to make our trial representative of the types of electrically heated buildings commonly found on our network.

Solar PV

Municipal buildings

We will select municipal buildings where potential substation constraints have been identified and where the customers' base load would be partially offset by the PV generation. Where possible we will try to engage with municipal building customers who fall within close proximity to customers targeted within the other intervention trials.

Substations

Firstly we will look at transformers that are near their name plate rating and have known or modelled high losses. The second stage will be to assess the suitability for PV, based on substation construction and the location with regards to shading and solar irradiance.

Appendix B.3: Trial Size Methodology

When carrying out site selection for PS+, analysis will be carried out to capture all substation typologies on our network, establishing those which are currently at or approaching their nameplate rating and are not included within our scheduled scheme of substation replacement within the period of the trial.

Once these substations are identified we will overlay housing archetype data for our region to establish those substations that will give a representative split of archetypes across each of the trials. We have used the industry standard five archetypes of primary fuel type, location, size, tenure and age as we have previously used in our demand forecasting and LCT uptake scenarios.

The below table shows a view of our projected overall trial sizes, including housing archetype numbers and projected over recruitment to allow for attrition over the trial.

Intervention	No of intervention types	Housing archetypes	Customers per housing archetype	Sample size	Over recruit %	Max sample (rounded)
1. Appliances	5	5	50	1250	5%	1315
2. Heating	1	2	50	100	5%	105
3. LED lighting	1	5	250	1250	5%	1315
4. Behaviour	1	5	250	1250	20%	1315
5. Street lighting	1	n/a	n/a	400	25%	500
6. PV municipal	1	n/a	n/a	10	0%	10
7. PV substations	1	n/a	n/a	30	0%	30
8. Combined	3	5	50	250	5%	265

Customer trials

For each of the customer interventions we have based the trial groups on a representative minimum sample size of 50 customers, which we have also identified as a representative average number of customers per substation feeder. We have then used the multiplier of five housing archetypes per trial to give a representative spread of housing types per trial.

As described in Section 2 and within the technical description in Appendix B.1, we will select a representative group of homes connected to each of the substations identified under the first phase of our site selection process. This will ensure that we are able to demonstrate and measure the impact of the interventions across all housing archetypes. Each chosen intervention will be installed in homes across multiple substations and feeders, in order to provide a thorough understanding of the impact of the intervention and its performance within different conditions.

Appliance trial

We anticipate that we will trial a representative group of the five types of intervention under the appliance trial. The five interventions will be dishwashers, tumble dryers, washing machines, fridges and freezers.

Heating trial

In contrast to the other customer interventions, we plan to conduct a smaller scale heating trial of around 100 customers. This is to make the trial group more representative of our network (electrically heated homes make up only 5% of our customers); also the intervention involves specific customer level monitoring and has a different set of customer sensitivities around heat and thermal comfort. We have selected two housing archetypes for the heat trial as electrical heating is most prevalent in older multi-occupancy private rented or social housing.

LED trial

The deployment of LED lights is likely to have a smaller measurable effect at customer level than the other interventions, therefore under this trial we plan to concentrate around single substations to saturate the local area with the intervention and measure the local network effects.

Behaviour trial

Building on the learning from our Power Saver Challenge project, we will run a trial across a group of 1 250 customers, demonstrating the result at a larger scale across a representative sample. We have allowed for an over recruitment of 25% on this trial because we have previously found that behavioural trial recruits have a higher attrition rate than those in more high value incentive driven trials.

Street lighting

Because a key focus of this trial will be engagement and price sensitivity with local authorities, we will aim to engage with four local authorities in our region, with a number of 100 lamps per region, lighting the streets of 500 homes in each region based on a representative 5:1 ratio of homes per street lamp.

Solar PV – municipal buildings

We have indicatively based our site selection for this trial upon deployment on schools, but this is subject to a full site selection process and engagement with the relevant stakeholders. Our load forecast modelling and business case indicate that up to 584 schools may need reinforcement due to load growth between 2018 and 2050. Scaling this back to within our trial gives a number of 50 substations; we will aim to successfully engage with 20% of this total.

Solar PV – substations

We will identify a number of substations that could be suitable for the deployment of PV subject to further investigation, to give a sample size of around 30.

Combined intervention

Because of the higher cost of deployment of multiple measures under a single trial, we will run a smaller trial group of 250, with three interventions deployed per customer.

Appendix C: Customer

This appendix describes the proposed methodology for the customer engagement strategy and communication; customer research and recruitment; reporting and analysis.

Project mobilisation

Mobilisation is expected to include a desktop literature review, incorporating current knowledge including substantive findings, as well as theoretical and methodological contributions to PS+. This will cover previous projects in this space and the latest findings from projects that are still in progress.

Customer groups

Customer segmentation and substation typologies

Existing customer segmentations such as GreenAware (incorporating environmentally relevant behaviours, attitudes and carbon footprint) will underpin analysis of the home energy survey to demonstrate key drivers and regional variations in behaviour. This will also include a review of secondary data sources, covering energy consumption data (substation level), classification of housing types, size, tenure and other demographic and socio-economic profiling.

The profile of domestic customers that take part in the trial and/or surveys will be matched to ACORN, a powerful consumer classification that segments the UK population by demographics, social factors, population and consumer behaviour.

SME customers who are included in trial areas will be matched by standard industrial classifications and survey responses, which will establish how critical electricity supply is to the business for its day-to-day functioning.

Attention will also be paid to the replicability of the segmentation analysis by other DNOs, favouring standard industry data and nationally available customer profile datasets. The exact number of typologies will be based on the analysis, but it is assumed that 4-8 would be an appropriate level of disaggregation.

To ensure findings are nationally applicable, the trial will consider representative networks across the Electricity North West region, including rural and urban configurations.

Because the PS+ trials have a whole system view, they will not focus solely on networks with a high proportion of customers in fuel poverty. However, to demonstrate that energy efficiency interventions have the ability to deliver a reduction in fuel poverty, trial regions will encompass networks comprised of customers fitting this profile, ie inner city housing estates and off gas networks.

A sample of customers fed by LV circuits that have been involved in previous innovation trials may be included within PS+ trials as appropriate, to optimise the use of monitoring devices already installed. This approach will benefit the research by providing at least 12 months' worth of historic network data, aggregated at feeder level, to act as a baseline to compare demand reduction driven by energy efficiency interventions, when equivalent data is collected during the trial. This approach will facilitate comparison analysis at substation and feeder level by day, time and season.

We anticipate that use of smart meters will be more prevalent on our network by the time the trial begins. Where customers in the trials have smart meters and we are able to access the data via the Data Communications Company, with customer consent we will access this data to inform the trial outputs.

Data and ethics

The acquisition and use of smart meter and other property specific or customer data by Electricity North West and its project partners will be subject to a stringent data privacy statement and the explicit consent of participating customers.

Trial interventions will be actively tested over a minimum 12-month period; customer engagement will take place over a longer period to accommodate recruitment and post-trial research to assess sustainability. Monitoring data will be obtained and assessed pre, during and post trial to substantiate network impact and customer feedback.

Customer impact on trial networks

Planned supply interruptions

Planned supply interruptions are not needed in PS+; monitoring equipment will be installed at distribution substations and we have identified monitoring technology that does not require customer supplies to be interrupted to enable installation.

Unplanned supply interruptions

PS+ will have no operational impact on customers directly or indirectly associated with the trial that is likely to result in an unplanned supply interruption.

Technology installation at customer premises

The technological retrofit interventions will be specifically selected to ensure they can be deployed safely, quickly and easily. If it is necessary to temporarily isolate an individual customer's supply to install an intervention, this will be arranged with customer consent at a mutually agreeable time; time spent off supply will be kept to a minimum to negate customer inconvenience.

Stakeholder engagement

Customer engagement activities in previous innovation projects have consistently demonstrated that there is limited awareness of Electricity North West and its role as a DNO in the wider electricity industry. Learning from the Power Saver Challenge project identified the importance of developing and using relationships with known and trusted partners from the local community. This is proven to add credibility to projects of this type and builds trust among a domestic audience. Involvement with local organisations positively impacts the recruitment of trial customers and critically, it also positively impacts retention of participants.

During project mobilisation, Electricity North West, in collaboration with project partners and experts in energy efficiency, will lead a series of stakeholder deliberative events involving local community groups, charities and housing providers. It is proposed that a minimum of two such events will take place, one with a general focus and potentially a further session with a specific emphasis on supporting vulnerable customers and those in fuel poverty in the trial area.

These events will comprise a blend of information-sharing and idea generation, the primary objective of which will be to establish a steering committee of engaged local organisations, able to provide a valuable community level resource to support customers and assist in maintaining customer retention for the duration of the project.

Regular updates will be provided on the progress of the trials and two-way communication and consultation mechanisms will be established to elicit feedback and to seek/deliver advice throughout the project. These partnership arrangements typically have wider societal benefits, generating a positive impact on the community as a whole. The Power Saver Challenge effectively demonstrated that when a range of community organisations act as positive ambassadors for energy efficiency, they can encourage these broader, less tangible social benefits, which positively influence those involved in the trial and can stimulate sustainable behavioural change.

Customer engagement and communication

Methodology, customer engagement plan and data privacy statement

A methodology statement will be published which outlines the customer research method and what each phase of engagement will entail. Before any relevant customers are invited to participate in the trial, we will provide Ofgem with a customer engagement plan and data privacy statement. While this is no longer a governance requirement, it is considered best practice to observe this approach in PS+ because of the extent and nature of proposed interactions with relevant customers and activities that will take place at customers' premises.

The documents will provide a framework for all engagement with customers who participate in, or who are affected either directly or indirectly by, the PS+ project. It will set out the activities and tools that Electricity North West and its project partners will draw upon to maximise customer outcomes.

To assess the impact of energy saving initiatives by customer segment, a range of data, including some personal data, will be collated during the life of the project. As such, the document will incorporate a data privacy statement, which outlines how this data will be managed and summarises the steps that will be taken to comply with the Data Protection Act 1998.

Mobilisation – customer strategy

Electricity North West will work with Impact Research and engaged customer panels to determine the communication materials required to educate and engage customers and agree how information is presented.

A general project and brand awareness campaign will be conducted in the defined geographic area to enhance perceptions of Electricity North West, ensuring relevant communities are familiar with the key role and responsibilities of the DNO. This messaging strategy and the associated customer communications materials will be informed by engagement with the local and wider community and consultation with engaged customer panels, to ensure that key customer segments are appropriately represented. The panel will be influential in the design of materials to maximise customer recruitment, learning and retention across the life of the project.

It is anticipated that ECP members and other early entrants/enthusiasts to the project may also act as positive ambassadors for the PS+ project, helping disseminate the benefit and advantages of taking part in the trial, at a local and community level.

Recruitment and engagement

A recruitment process map will be produced to document key activities and associated dates. This phase will draw on techniques that have been effective in previous innovation projects, most notably Power Saver Challenge.

Drawing on the learning from Power Saver Challenge, the proposed recruitment methodology is likely to include community and face-to-face events and will be supported by more traditional techniques such as leafleting and mailshots. We will also deploy direct engagement methods, which are likely to include door-to-door, phone, digital and social media.

The priority services register (PSR) will be signposted during the customer engagement/ recruitment process. With the explicit consent of the customer, this will enable trusted project partners to record and share defined vulnerable customer data with Electricity North West, facilitating registration on the PSR.

A central service will be established to support all trial customers, as required, throughout the project. The service will provide advice and support during the technology installation phase, but will be available to offer on-going support and energy efficiency advice to trial participants across the life of the project

Customer retention

Sustaining engagement will be key to the success of this project and trial participants will be provided with regular updates and/or given energy efficiency advice, dependent upon the particular trial intervention. It is anticipated that this ongoing activity will be key to maintaining customer retention. Updates and information will be delivered and available via a number of communication platforms.

Customer surveys

The impact of energy saving initiative on perceptions, attitudes and behaviours will be measured by quantitative and qualitative customer research matched against actual consumption and network data. The findings will provide a blueprint for how best to engage with specific customer segments to promote energy saving initiatives. The blueprint is expected to inform which initiatives, or combination of initiatives, generate the most impact in reducing consumption, and if these vary by customer type.

The anticipated research outcomes of the customer surveys are:

- Measure the success of the PS+ awareness campaign
- Understand the key drivers and barriers for participating in the PS+ trial
- Benchmark and monitor participants' receptiveness to changing their behaviour
- Benchmark and monitor participants' (claimed) energy usage behaviour
- Understand whether households notice a reduction in their consumption
- Understand whether households perceive any wider societal or other benefits.

A robust sample size is required for every type of intervention trialled to ensure its true impact can be properly assessed. A trial framework will be developed to examine the effectiveness of each of the energy efficiency interventions being tested.

The interventions will be trialled one initiative per customer and in parallel with other physical interventions or behavioural advice as set out in Figure C.1. This protocol may affect the duration of the test period required before any impact on consumption is identified.

Figure C.1: Trial regime

Method	Energy efficiency interventions
Trial 1	Retrofit energy efficient appliances in customer premises
Trial 2	Retrofit energy efficient electrical heating in customer premises
Trial 3	Retrofit energy efficient lighting in customer premises
Trial 4	Energy efficiency behavioural advice delivered to customers
Trial 5	Retrofit energy efficient street lighting
Trial 6	Retrofit roof mount solar PV installations on municipal buildings
Trial 7	Retrofit roof mount solar PV installations on substations
Trial 8	Combined measures (lighting, appliance and behaviour)

Eligibility / screening questionnaire

As part of recruiting customers into the trial, initial profiling data will be collected, documenting basic demographic information for all test participants. This will be used for eligibility screening and segmentation, ensuring appropriate quotas are obtained to robustly demonstrate the initiatives that are most effective in each customer segment.

Baseline survey / home energy visit

A baseline survey of trial participants will be conducted, which will combine an audit of each household including: its size and composition; the type and number of appliances; current consumption behaviour and a measure of the household's attitudes and perceptions to energy; environmental issues; bills as a proportion of income and perceived impact of energy saving/bill reduction on the household.

The survey will align to the package of measures to be trialled in homes and SME premises. These surveys will influence which interventions or suite of interventions will be deployed across specific feeders. Participants will be informed after this visit which intervention will be applied at their property.

Survey 2: mid-trial changes in behaviour

A mid-trial survey will be conducted to understand behavioural changes and any reduction in the electricity consumption/bills of these households. Respondents will be given the opportunity to report any issues or concerns with the various interventions, specific to their property and these matters will be handled appropriately.

Survey 3: end-of-trial

Following completion of the trial, all participating households will be re-contacted to gauge overall reaction to the trial, any reduction in electricity consumption/bills, behavioural changes and sustainability of behavioural change.

Survey 4: sustainability

Participants will be contacted around six to 12 months after completion of the trial, to test if behavioural change is sustained without further engagement or incentive. This will elicit key drivers and barriers to maintaining behaviour change in the future and any changes in perceptions/attitudes to energy usage and efficiency.

Incentives will be offered to customers taking part in the trial and research. It is envisaged that a total of £100 per participant will be distributed in instalments, for active participation in the surveys. The value of the payments is likely to be weighted towards the end of the project to encourage retention in the trial with the higher rewards being distributed for the final surveys.

Analysis and reporting

The key objective of the project is to bring together technical data and customer perception data to assess the effectiveness of the energy reduction initiatives and understand the optimal approach. Customer feedback will be analysed to assess the extent to which the various interventions have achieved success against pre-defined action standards. This will shape the development of the Power Saver Tool, informing an appropriate energy efficiency strategy that could be rolled out across the Electricity North West region and GB.

Interim lessons learned reports will be produced to disseminate the key findings as the project progresses at mid-trial, end-of-trial and post-trial periods. A key outcome for the closedown report will be a blueprint for a DNO-led targeted customer energy efficiency programme which can effectively deliver reduced electricity bills for customers, reduced distribution network costs and achieve Carbon Plan commitments.

Appendix D: Innovation Review

In the past decade the electricity industry has increased its level of innovation to support the transition to a low carbon economy while delivering an improving service at the best possible cost to the end customer.

To date approximately 760 projects have received funding through one of four mechanisms: Low Carbon Networks Fund (LCN Fund), Innovation Funding Incentive (IFI), Network Innovation Competition (NIC) or Network Innovation Allowance (NIA). Hence it is crucial to identify core crossovers and areas where there is an unproven business case that requires investigation.

Project analysis

The proposed project builds upon strong foundations laid by the Electricity North West Power Saver Challenge project which ran between October 2013 and April 2015. The project provided a proof-of-concept, testing the feasibility of avoiding investment in an urban primary substation through working with customers to reduce the amount of electricity they use, in return for a reward.

However, to grow the project and effectively unlock further value from the network, all other innovation projects within the same space must be considered. Following a comprehensive review of all the LCN Fund and NIC projects, 12 projects were identified as significant.

Figure D.1: LCN Fund and NIC projects significant to PS+

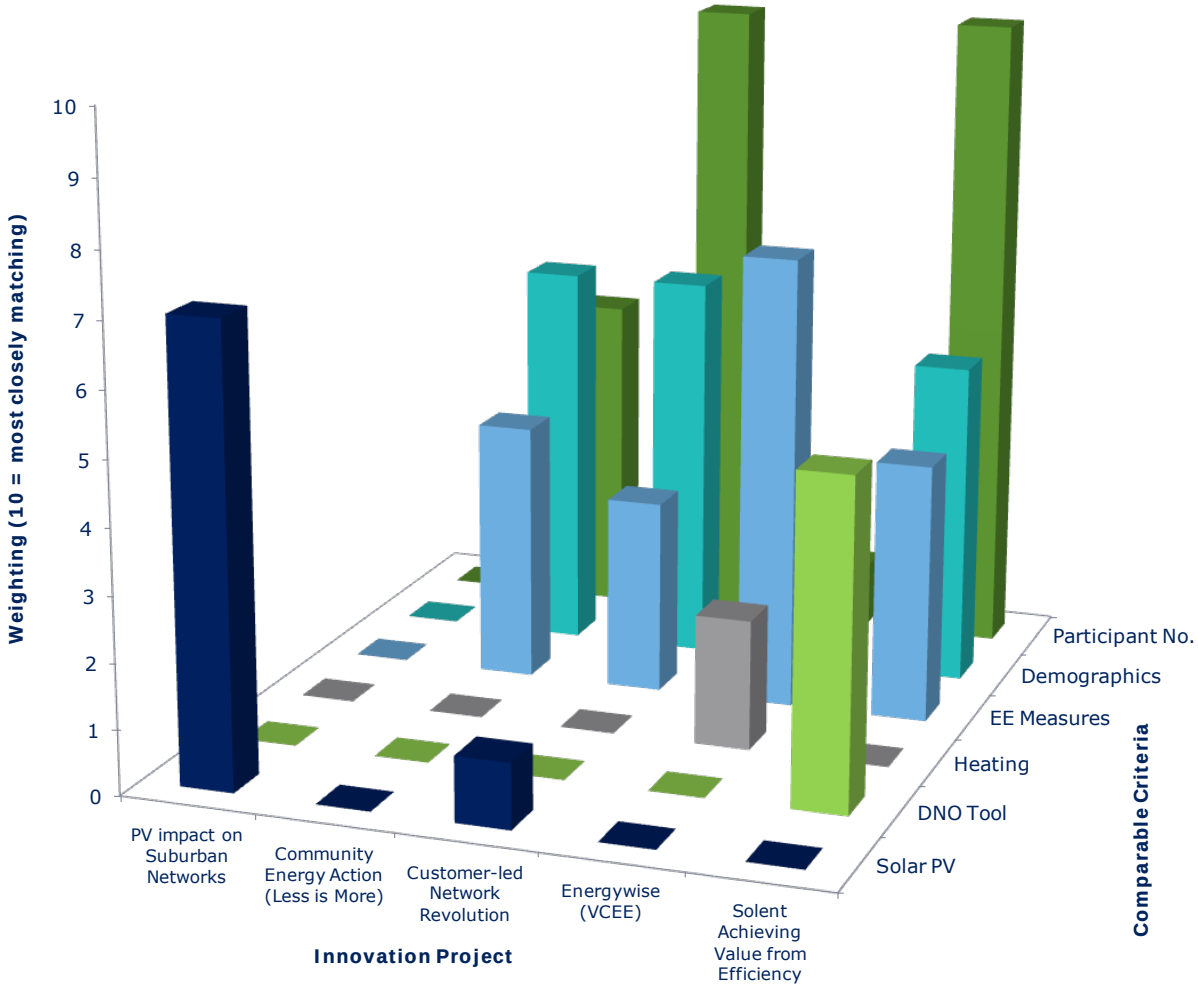
Project name	DNO	Funding platform	Innovation funding (£k)	End date
Open LV	Western Power Distribution	NIC	£4 855k	April 2020
Solent Achieving Value from Efficiency	Scottish and Southern Energy	Second Tier LCN Fund	£8 293k	June 2018
Energywise (VCEE)	UK Power Networks	Second Tier LCN Fund	£3 322k	December 2017
Smart Street (eta)	Electricity North West	Second Tier LCN Fund	£8 438k	December 2017
Customer-led Network Revolution	Northern Power Grid	Second Tier LCN Fund	£27 353k	December 2013
My Electric Avenue (I²EV)	Scottish and Southern Energy	Second Tier LCN Fund	£4 175k	December 2015
BRISTOL	Western Power Distribution	Second Tier LCN Fund	£2 204k	January 2015
Flexible Urban Networks - LV	UK Power Networks	Second Tier LCN Fund	£6 528k	December 2016
Community Energy Action (Less is More)	Western Power Distribution	First Tier LCN Fund	£434.57k	May 2015
Low Voltage Network Solutions	Electricity North West	First Tier LCN Fund	£1 490k	March 2014

Project name	DNO	Funding platform	Innovation funding (£k)	End date
Validation of PV Connection Assessment Tool	UK Power Networks	First Tier LCN Fund	£367k	November 2014
PV impact on Suburban Networks	Western Power Distribution	First Tier LCN Fund	£100k	November 2013

IFI and NIA projects were considered, yet those deemed significant were superseded by larger LCN Fund and NIC funded projects which are included in Figure D.1.

The projects all include elements which will direct the PS+ project delivery team, but all are not equally weighted. This is due to their individual scopes and varying degree of learning in areas with a potential overlap. To identify the projects of primary importance a rating matrix was created, providing each project with a scoring against a common criterion which closely fits PS+.

Figure D.2: Weighting of LCN Fund and NIC correlations with PS+



From Figure D.2, four projects can be seen to present the greatest number of commonalities. Through further reading, SAVE and Energywise were found to offer the most up to date and relevant outputs. To limit duplication and facilitate more direct cross-DNO learning, we have held discussions with Scottish and Southern Energy Networks and UK Power Networks.

While learning from Energywise has and will continue to direct the PS+ project, its vulnerable and fuel poor customer focus limits crossover and its input into detailed scoping of the Power Saver Tool.

The second SAVE trial is presently in progress with the third to follow in late 2018, thus a greater opportunity to collaborate and inform each other's next phase (including knowledge dissemination and business as usual adoption) has been determined.

Electricity North West aims to work closely with Scottish and Southern Energy Networks who agree this approach is necessary to gain the learning required to drive effective domestic level efficiency and deliver the best overall value to the end customer. Hence Scottish and Southern Energy Networks have provided a letter of support for PS+.

Solent Achieving Value from Efficiency (SAVE)

Project scope

SAVE set out to establish the extent to which energy efficiency interventions can be considered as a cost-effective, predictable and sustainable tool for managing demand on electrical networks as an alternative to traditional reinforcement.

The project aimed to gain insight into the drivers of energy efficient behaviour for specific types of customers, identify the most effective channels to engage and gauge the effectiveness of different measures in eliciting energy efficient behaviour with customers. Solent was the area selected for the trial as it was believed to provide the cross-section of customer types required (urban deprived and semi-rural wealthy) and the number of trial participants required to deliver the following four interventions:

- DNO coaching
- DNO coaching with time pricing signals
- Community coaching
- Light-emitting diode (LED) offerings.

At the core of this project sits in-home energy consumption and power monitoring through which signals can be sent to investigate the effectiveness of pricing signals. This data alongside the demographic variations could then be used to perform customer and network modelling, identifying where this approach could be taken in place of traditional reinforcement.

Key outcomes/significant learning

The project is presently preparing for the second trial phase, with another to follow in mid-2018 due to an unplanned delay of the project. When the live trials started in 2017, they had recruited 4 000 customers. However, the in-home monitoring is portable in nature resulting in a number of communication links being severed due to customer interaction with the equipment. The only low energy devices being deployed in this project are LED light bulbs and to date this has been through providing access to a website offering a range of discounted bulbs. There have been a number of views, highlighting the effectiveness of the engagement, but only a very small selection of the overall customer base have progressed to a purchase.

Energywise

Project scope

Energywise aimed to understand the extent to which residential customers classified as fuel poor or vulnerable would be able to engage in energy efficiency interventions or off-peak tariffs (delivered by partner British Gas). Through the domestic energy bill the group pay for the low carbon transition, but they are the least likely to benefit from it unless there is direct support from the energy industry. Thus the project set out to identify the best approaches for engaging this group of customers to unlock benefits through smarter use of domestic energy.

A research study aimed to recruit 550 households in the London Borough of Tower Hamlets to take part in two trials, each testing different ways of helping households better understand and control their energy spending. These included:

- Installing smart metering devices and energy efficiency technologies (such as energy efficient light bulbs, eco-kettles and standby savers)
- Swapping to an 'off-peak' tariff, aimed at changing consumer energy consumption behaviour by offering favourable off-peak rates.

Throughout this process a review of best practice in fuel-poor customer engagement was conducted. Analysis is presently underway to provide evidence to DNOs on how this group's energy demand may change and as a result what impact such an approach may have on the peak load of local distribution substations.

Key outcomes/significant learning

The project is still in its trial period so energy saving, customer engagement and energy shifting phases are presently underway. The project has undergone a delay due to challenges with completion of the recruitment and installation phase. It was found that the most successful means of recruitment was face-to-face (60%) and that sharing cultural characteristics and local knowledge with the target customer pool enables successful build-up of trust. The main motivation for signing up was saving money in the long run. Use of energy efficiency devices and being part of a research project was the lowest motivational factor.

The project team and their partners have approached 1 352 households and successfully secured 538 participants all of whom were credit metered customers that required standard communications for smart meter installation. Of the 538 sign-ups, 304 are still active in the project while 234 have dropped out.

Community Energy Action

Project scope

The project focused on determining if demand side response is effective for communities provided with demand information and an incentive mechanism. In total ten communities with at least 50 domestic addresses were selected, defined by their connection to a single substation. There was no grouping of customer or housing type and the core exclusion were those with high domestic PV penetration.

All energy consumption and power usage was derived from substation monitoring. Once collated, this data was shared with the communities involved in the trial through local energy charities who also delivered energy saving advice. In addition to advice, communities were incentivised to reduce demand during peak periods using time of use (ToU) tariffs.

Key outcomes/significant learning

The trial found no statistically significant variations in demand due to the interventions carried out. The ability for community-focused demand side response to circumvent DNO asset overloads was therefore unproven. Costly customer engagement alone significantly outweighed the costs of conventional reinforcement in the cases trialled.

Working as a group or community encouraged participation according to participant feedback, yet a lack of community interest was not identified as a barrier to deployment of demand side response (DSR) strategies.

Appendix E: Behaviour Sustainability Report – Understanding Behavioural Persistence, a report by the Energy Saving Trust

Introduction

As an organisation, Energy Saving Trust is continually striving towards estimating the savings that can be achieved through energy efficiency improvements as accurately as possible. Our evaluations calculate the annual and lifetime CO_2 savings based on standard CO_2 assumptions.

The assumptions for lifetime savings associated with 'hard' insulation or heating measures installed by customers are robust and approved by the Energy Saving Trust's data services team[12]. The lifetime savings associated with behaviour change are more uncertain, however, as there has been little work carried out on the longevity of behaviour change.

This paper covers two reviews looking at understanding the persistence of behavioural change:

- A study that was conducted by Energy Saving Trust's evaluation team in 2009 and updated in 2012 and 2014 to estimate the longevity of behaviour change
- A literature review of external studies on estimating the longevity of behaviour change.

Energy Saving Trust Persistence Study

Study aim

Evaluation of advice centres operated by Energy Saving Trust has been undertaken quarterly since 2005. In 2009, a study was undertaken by the evaluation team to go back to respondents of previous evaluations to explore whether they were still doing the behaviours they reported in the initial survey. This allowed an understanding of the longevity of behaviours over a three-year period. The results showed that the majority of customers that had originally changed their behaviour following the advice had continued with the new behaviours. In 2012, a further survey was commissioned to follow these respondents up again, to understand if these behaviours were still in place six years later. The main objective of the research was to understand the number of years that behaviour changes persist for.

Methodology

In the original longitudinal study in 2009, 564 quantitative telephone interviews were conducted with customers that had originally been interviewed between 2005/6 and 2007/8. 440 of the 564 respondents in 2009 said that they would be willing to be contacted for further research; these were used as the basis of this year's 2012 survey sample. In total, 240 telephone interviews were conducted. The questionnaire included the same core questions as the 2009 study so that the answers could be compared.

The evaluation covered seven behaviours:

- Turning the lights or lamps off in empty rooms when they are not being used
- Only using the washing machine when there is have a full load to wash
- Turning the heating thermostat down by one degree or more
- Only putting in as much water as needed when boiling a kettle
- Turning off household appliances instead of leaving them on standby
- Washing clothes at 30°C instead of higher temperatures
- Walking instead of taking the car for short journeys.

[12] The savings for measures are reviewed on an annual basis by the data team and are based on SAP – the UK government's recommended method for estimating the energy performance of residential dwellings.

Limitations

The survey was not a general public survey; it only covered the Energy Saving Trust's customers and only included customers that reported to have made a behavioural change as a result of Energy Saving Trust advice between 2005/6 and 2007/8.

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Year

Literature review

A review was conducted to document any existing literature on the longer-term persistence of behaviours after the delivery of interventions designed to encourage pro-environmental behaviour change (Table 4). The literature largely focused on a handful of behaviour change strategies including giving information, giving feedback and the setting of energy saving targets (goal setting). There was very little work looking at the effectiveness of interventions similar to those interventions favoured by the Home Energy Scotland advice centres, ie around giving tailored advice (personalised information). Many of the studies examined did not explicitly test how long introduced behaviours can last, often just recording whether the target behaviour had persisted to some pre-determined follow up date. This means that the maximum observed life time reported for each study listed in Table 4 is not an estimate of how long the behaviours are likely to have persisted, but just the latest date at which a statistically-significant change in the target behaviours, or the target behaviours' outcomes, were measured. Anecdotally, it was noted in Darby (2006) that "*If someone was going to return to their old inefficient habitual ways they would do so within three months. In our experience, if they have*

[13] The difference between the proportion of customers still practising the easy behaviours and those practising the more challenging behaviours is significant at the 90 per cent confidence interval.

adopted a change in behaviour for over three months they have changed for at least a year." As this is only anecdotal evidence, it should be treated with caution.

As none of the studies reviewed in Table 4 monitored persistence for as long as we have in the original data presented here, we believe that our data is the most relevant piece of research on how long behaviour change persists after a household receives tailored advice.

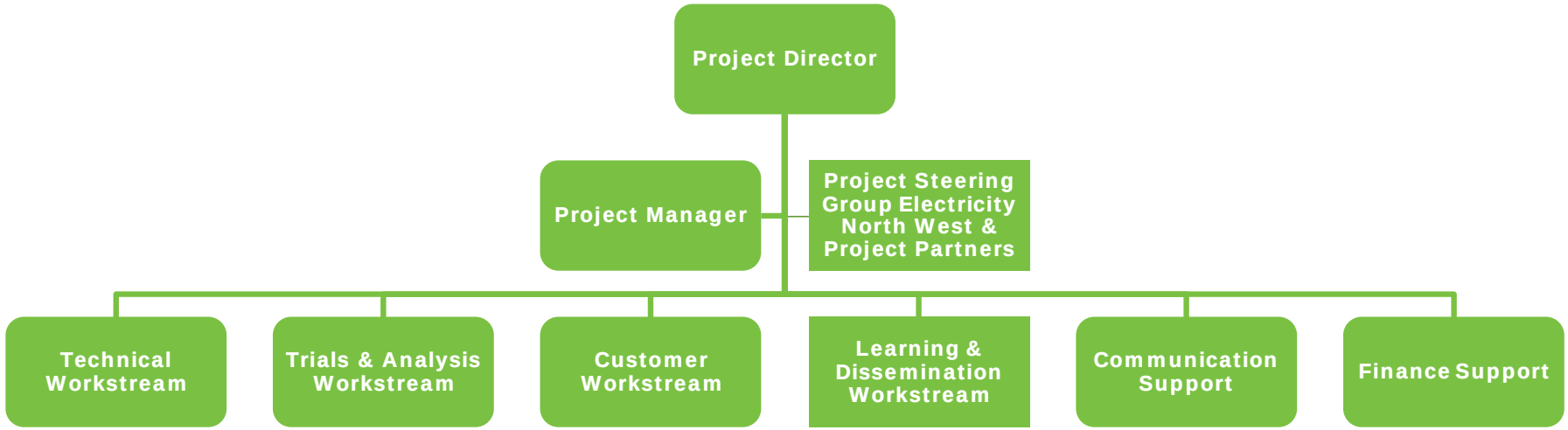
Bibliography

- Bittle, R.G., Valesano, R. and Thaler, G., 1979. The effects of daily cost feedback on residential electricity consumption. Behavior Modification, 3(2), pp.187-202.
- Darby, S. (2006). The effectiveness of feedback on energy consumption. A Review for DEFRA of the Literature on Metering, Billing and direct Displays, 486
- Gonzales, M.H., Aronson, E. and Costanzo, M.A., 1988. Using social cognition and persuasion to promote energy conservation: A quasi-Experiment. Journal of Applied Social Psychology, 18(12), pp.1049-1066.
- Hayes, S. C., & Cone, J. D. (1981). Reduction of residential consumption of electricity through simple monthly feedback. Journal of Applied Behavior Analysis, 14, 81–88.
- Hirst, E., & Grady, S. (1982–1983). Evaluation of a Wisconsin utility home energy audit program. Journal of Environmental Systems, 12(4), 303–320.
- Houde, S., Todd, A., Sudarshan, A., Flora, J. A., & Armel, K. C. (2013). Real-time feedback and electricity consumption: A field experiment assessing the potential for savings and persistence. The Energy Journal, 34(1), 87-102
- McDougall, G. H. G., Claxton, J. D., & Ritchie, J. R. B. (1982–1983). Residential home audits: An empirical analysis of the ENEVERSAVE program. Journal of Environmental Systems, 12(3), 265–278.
- Pitts, R. E., & Wittenbach, J. L. (1981). Tax credits as a means of influencing consumer behavior. Journal of Consumer Research, 8,335–338
- Staats, H., Harland, P., & Wilke, H. A. M. (2004). Effecting durable change. A team approach to improve environmental behavior in the household. Environment and Behavior, 36(3), 341–367.
- Van Houwelingen, J. H., & Van Raaij, F. W. (1989). The effect of goal setting and daily electronic feedback on in-home energy use. Journal of Consumer Research, 16, 98–105
- Wilhite, H., Ling, R. (1995) Measured energy savings from a more informative energy bill, Energy & Buildings, , Vol.22(2), pp.145-155
- Winett, R. A., Neale, M. S., & Grier, H. C. (1979). Effects of self monitoring and feedback on residential electricity consumption. Journal of Applied Behavior Analysis, 12(2), 173–184.
- Winett, R.A., Leckliter, I.N., Chinn, D.E., Stahl, B. and Love, S.Q., 1985. Effects of television modeling on residential energy conservation. *Journal of applied behavior analysis*, *18*(1), pp.33-44.

Table 4: Review of literature concerned with the persistence of pro-environmental behaviours after an intervention

Citation	Target behaviour	Behaviour change lever	Maximum observed life time (years)	Sample size
Bittle et al. (1979)	Undefined electricity related behaviours	Feedback	0.1	30
Gonzales et al. (1988)	Loft and wall insulation, water heater insulation	Information, financial	0.4	408
Hayes and Cone (1981)	Undefined electricity related behaviours	Feedback	0.2	40
Hirst and Grady (1982–1983)	Undefined gas related behaviours	Information	2	850
Pitts and Wittenbach (1981)	Buying home insulation	Financial	0	146
Staats et al. (2004)	Insulation of heating system, turning down central heating, turning down water temperature, reducing shower times, increasing number of energy saving light bulbs, switching television to off rather than standby	Information, feedback, comparative feedback	2	150
Van Houwelingen and Van Raaij (1989)	Undefined gas related behaviours	Feedback, goal setting, self-monitoring, information	< 1	285
Winett et al. (1979)	Thermostat control, retrofitting, improved appliance use	Feedback, self-monitoring	0.2	71
Winett et al. (1985)	Use of natural ventilation and shading, thermostat control	Social learning, information	< 1	150
McDougall et al. (1982–1983)	Lowering thermostat settings, adding insulation to walls and loft	Information	2	1 400
Houde et al (2013)	Turning lights off that aren't needed, turn off power strips, washing laundry in 'cold' water	Feedback	0.7	1 065
Darby (2006)	Undefined energy related behaviours	Feedback	1	
Wilhite and Ling (1995)	Reducing house temperature, water-saving equipment installations, using a washing up bowl	Information, feedback	3	1 286

Appendix F: Project Management Office



Technical Workstream

- Install energy efficiency interventions
- Install monitoring equipment

Trials & Analysis Workstream

- Site selection and trial design
- Analyse trial data
- Design and develop the Power Saver Tool with user guide
- Review, update and compare CBA model

Customer Workstream

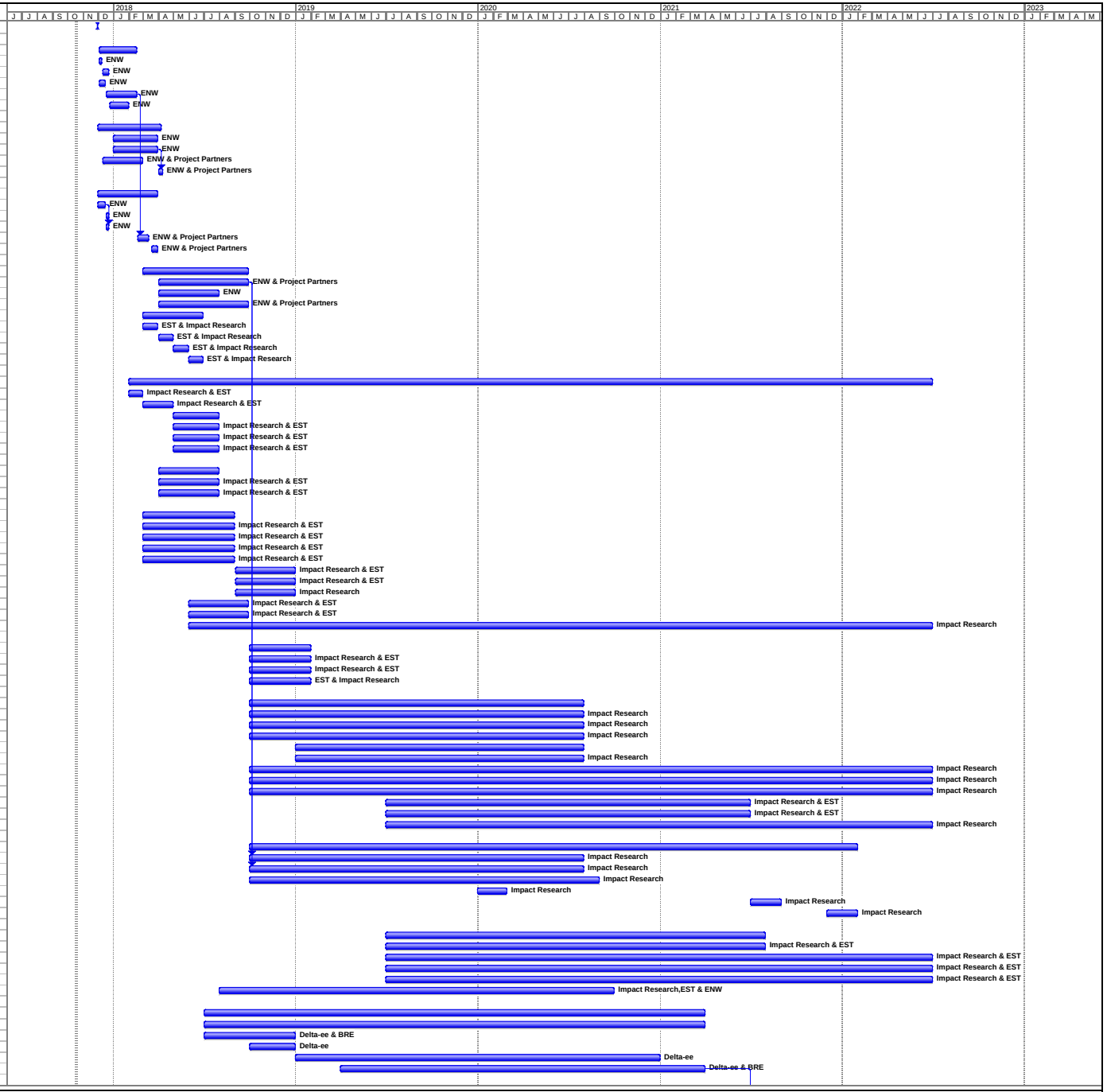
- Methodology statements
- Stakeholder engagement
- Customer segmentation and sub-station typologies
- Communication material
- Customer engagement
- Home energy visit
- Recruitment of trial participants
- Baseline and trial surveys
- Reporting and analysis

Learning & Dissemination

Knowledge generated and shared by Power Saver Plus: Good practice guide on personal data, new knowledge of effective techniques in engaging with customers to obtain their buy in to energy efficiency measures, Report detailing suppliers vs distribution companies to deliver energy efficiency, an enhanced CBA model and the Power Saver Tool.

Appendix G: Project plan

ID	Task Name	Duration	Start	Finish	Predecessors
1	**NIC Fund Award Announcement**	1 day?	Thu 30/11/17	Thu 30/11/17	
2					
3	**Phase 1a) Project Readiness**	55 days?	Mon 04/12/17	Fri 16/02/18	
4	Project Governance embedded into existing governance structure	5 days?	Mon 04/12/17	Fri 08/12/17	
5	Review and agree Project Direction	10 days?	Mon 11/12/17	Fri 22/12/17	
6	Develop and send out partner contracts	10 days?	Mon 04/12/17	Fri 15/12/17	
7	Review and negotiate contracts	45 days?	Mon 18/12/17	Fri 16/02/18	
8	Design, develop and issue the project implementation documents	28 days?	Mon 25/12/17	Wed 31/01/18	
9					
10	**Phase 1b) Mobilisation**	91 days?	Fri 01/12/17	Fri 06/04/18	
11	Identify and mobilise project management office	65 days?	Mon 01/01/18	Fri 30/03/18	
12	Identify and mobilise project team	65 days?	Mon 01/01/18	Fri 30/03/18	
13	Partner resourcing	58 days?	Mon 11/12/17	Wed 28/02/18	
14	Project management office and partner resources mobilisation meeting	6 days?	Mon 02/04/18	Mon 09/04/18	12
15					
16	**Financial and contractual**	86 days?	Fri 01/12/17	Fri 30/03/18	
17	Identify and implement project budget controls within ENW	11 days?	Fri 01/12/17	Fri 15/12/17	
18	Set up project bank account	5 days?	Mon 18/12/17	Fri 22/12/17	
19	Financial controls established	5 days?	Mon 18/12/17	Fri 22/12/17	17
20	Partnership relationship discussions	16 days?	Mon 19/02/18	Mon 12/03/18	7
21	Contractual agreement signed	10 days?	Mon 19/03/18	Fri 30/03/18	
22					
23	**Phase 2) Site selection and trial design**	152 days?	Thu 01/03/18	Fri 28/09/18	
24	Finalise site selection methodology	130 days?	Mon 02/04/18	Fri 28/09/18	
25	Get in contact with all street lighting local authorities to find out where LED lights	87 days?	Mon 02/04/18	Tue 31/07/18	
26	Finalise trial design	130 days?	Mon 02/04/18	Fri 28/09/18	
27	**Customer segmentation and substation typologies**	87 days?	Thu 01/03/18	Fri 29/06/18	
28	Identification of target areas	22 days?	Thu 01/03/18	Fri 30/03/18	
29	Analysis of available data to form the substation typologies	21 days?	Mon 02/04/18	Mon 30/04/18	
30	Address level data gathering, ETL, merging, quality checking and consolidation	23 days?	Tue 01/05/18	Thu 31/05/18	
31	Analysis of the data to identify and group common typologies of substations acc	21 days?	Fri 01/06/18	Fri 29/06/18	
32					
33	**Workstream - Customer**	1151 days	Thu 01/02/18	Thu 30/06/22	
34	Project initiation meeting	20 days?	Thu 01/02/18	Wed 28/02/18	
35	Literature review and report	43 days?	Thu 01/03/18	Mon 30/04/18	
36	**Stakeholder engagement**	66 days?	Tue 01/05/18	Tue 31/07/18	
37	2 deliberative events (targeted at local trusted organisations)	66 days?	Tue 01/05/18	Tue 31/07/18	
38	Establishment of a customer engagement steering committee	66 days?	Tue 01/05/18	Tue 31/07/18	
39	4 depth interviews with key stakeholders	66 days?	Tue 01/05/18	Tue 31/07/18	
40					
41	**Methodology statement DPS, CEP**	87 days?	Mon 02/04/18	Tue 31/07/18	
42	Production	87 days?	Mon 02/04/18	Tue 31/07/18	
43	Peer review	87 days?	Mon 02/04/18	Tue 31/07/18	
44					
45	**Customer engagement set up (marketing, programme and systems)**	132 days?	Thu 01/03/18	Fri 31/08/18	
46	Development of initial programme messaging and branding	132 days?	Thu 01/03/18	Fri 31/08/18	
47	Development of a customer journey map	132 days?	Thu 01/03/18	Fri 31/08/18	
48	Development of a data flow map	132 days?	Thu 01/03/18	Fri 31/08/18	
49	Development of a draft marketing and channel strategy	132 days?	Thu 01/03/18	Fri 31/08/18	
50	Development of engagement material, content, website content and collateral fo	86 days?	Mon 03/09/18	Mon 31/12/18	
51	Re-convened focus group and depth interviews with residents to trial programm	86 days?	Mon 03/09/18	Mon 31/12/18	
52	Development of web page with information and customer sign up form and on g	86 days?	Mon 03/09/18	Mon 31/12/18	
53	Recruitment/training and systems set up for telephone contact centre	86 days?	Fri 01/06/18	Fri 28/09/18	
54	Build bespoke Power Saver Plus CRM database	86 days?	Fri 01/06/18	Fri 28/09/18	
55	Ongoing engagement with partner organisations, stakeholder and community le	1065 days?	Fri 01/06/18	Thu 30/06/22	
56					
57	**Home energy visit preparation**	89 days?	Mon 01/10/18	Thu 31/01/19	
58	Design of in home surveys aligned to packages of measures to be trialled in hon	89 days?	Mon 01/10/18	Thu 31/01/19	
59	Recruitment and training of in home assessors in the local area and from local c	89 days?	Mon 01/10/18	Thu 31/01/19	
60	Development of an integrated in home and online advice tool	89 days?	Mon 01/10/18	Thu 31/01/19	
61					
62	**Customer engagement - communication, recruitment and support**	480 days?	Mon 01/10/18	Fri 31/07/20	
63	Launch and delivery of an omni-channel marketing PR and comms activity	480 days?	Mon 01/10/18	Fri 31/07/20	
64	Sign up of customers and registration via CRM	480 days?	Mon 01/10/18	Fri 31/07/20	
65	Deliver of a welcome pack to participants	480 days?	Mon 01/10/18	Fri 31/07/20	
66	Customers bringing other customers into the project	414 days?	Tue 01/01/19	Fri 31/07/20	
67	Selection of energy champions	414 days?	Tue 01/01/19	Fri 31/07/20	
68	Supporting customer through installation of technologies, booking installation tim	979 days?	Mon 01/10/18	Thu 30/06/22	
69	Administration of project intervention incentives	979 days?	Mon 01/10/18	Thu 30/06/22	
70	Providing ongoing support and advice to trial participants, answering questions	979 days?	Mon 01/10/18	Thu 30/06/22	
71	Designing and running a programme of face to face engagement	523 days?	Mon 01/07/19	Wed 30/06/21	
72	Deliver of workshops and engagement activity in collaboration with local partner	523 days?	Mon 01/07/19	Wed 30/06/21	
73	Handling ongoing proactive trial communications - proactive updates to real part	784 days?	Mon 01/07/19	Thu 30/06/22	
74					
75	**Customer surveys**	871 days?	Mon 01/10/18	Mon 31/01/22	
76	Eligibility/screening questionnaire	480 days?	Mon 01/10/18	Fri 31/07/20	24
77	In home survey booking and liaison with in home assessors	480 days?	Mon 01/10/18	Fri 31/07/20	24
78	Survey 1: Baseline/home energy visit	501 days?	Mon 01/10/18	Mon 31/08/20	
79	Survey 2: mid trial survey	43 days?	Wed 01/01/20	Fri 28/02/20	
80	Survey 3: end of trial survey	44 days?	Thu 01/07/21	Tue 31/08/21	
81	Survey 4: six months after trial	44 days?	Wed 01/12/21	Mon 31/01/22	
82					
83	**Reporting and analysis**	545 days?	Mon 01/07/19	Fri 30/07/21	
84	Interim analysis - ongoing liaison between project partners to analyse monitoring	545 days?	Mon 01/07/19	Fri 30/07/21	
85	A blue print of how to best engage with specific customer segments with regards	784 days?	Mon 01/07/19	Thu 30/06/22	
86	Analysis of customer survey data against action standards	784 days?	Mon 01/07/19	Thu 30/06/22	
87	Analysis of technical consumption data	784 days?	Mon 01/07/19	Thu 30/06/22	
88	Good practice guide on personal data related to Power Saver Plus as a BaU	566 days?	Wed 01/08/18	Wed 30/09/20	
89					
90	**Workstream - Trials and Analysis**	718 days	Mon 02/07/18	Wed 31/03/21	
91	**Monitoring trial data analysis**	718 days?	Mon 02/07/18	Wed 31/03/21	
92	Analysis design and development of framework for collating data	131 days?	Mon 02/07/18	Mon 31/12/18	
93	Review of analysis framework for collating data	66 days?	Mon 01/10/18	Mon 31/12/18	
94	Data transfer, review and cleansing of data	523 days?	Tue 01/01/19	Thu 31/12/20	
95	Analysis of the data from the trial	523 days?	Mon 01/04/19	Wed 31/03/21	
96					

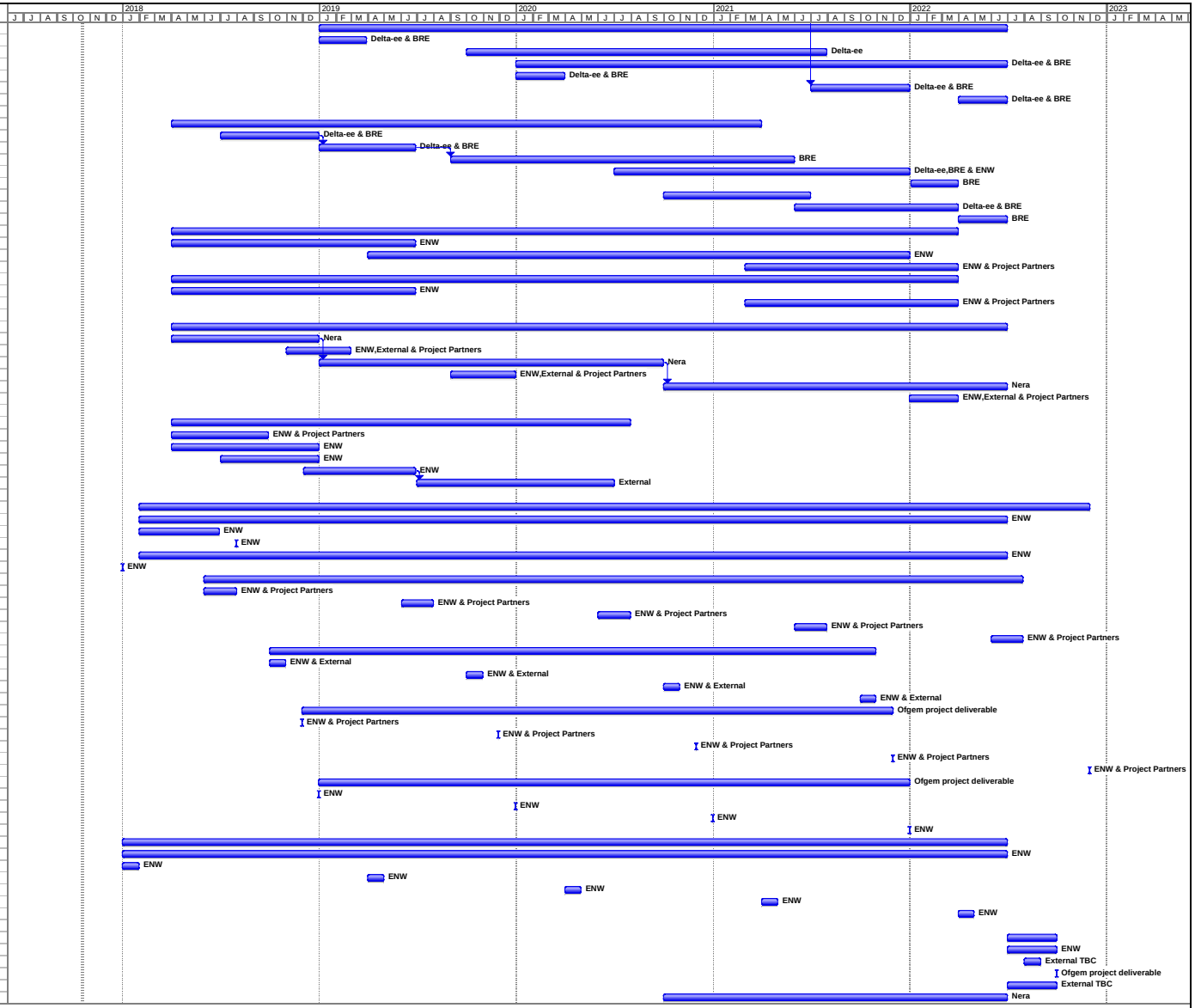


Project: Power Saver Plus Project Plan
Date: Tue 17/10/17

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Page 1

ID	Task Name	Duration	Start	Finish	Predecessors
97	**Reporting on trial data and key learning's for dissemination**	913 days?	Tue 01/01/19	Thu 30/06/22	
98	Performance analysis framework report (methodology)	64 days?	Tue 01/01/19	Fri 29/03/19	
99	Performance monitoring reporting (performance of energy efficiency measures)	479 days?	Tue 01/01/19	Fri 30/07/21	
100	Dissemination reporting, key learning's from the project	652 days?	Wed 01/01/20	Thu 30/06/22	
101	Assume some learning's from early trial data - feed back into project	65 days?	Wed 01/01/20	Tue 31/03/20	
102	Write up of full trial data / results	132 days?	Thu 01/07/21	Fri 31/12/21	95
103	Dissemination reporting / support	65 days?	Fri 01/04/22	Thu 30/06/22	
104					
105	**Designing and development of the Power Saver tool**	783 days?	Mon 02/04/18	Wed 31/03/21	
106	Scoping	131 days?	Mon 02/07/18	Mon 31/12/18	
107	Designing	129 days?	Tue 01/01/19	Fri 28/06/19	106
108	Build	456 days?	Mon 02/09/19	Mon 31/05/21	107
109	Testing, evaluation and refinement	393 days?	Wed 01/07/20	Fri 31/12/21	
110	Energy efficiency merit order tool	64 days?	Mon 03/01/22	Thu 31/03/22	
111	**Reporting on the Power Saver tool and user guide**	195 days?	Thu 01/10/20	Wed 30/06/21	
112	User guide, summary of tool design, key assumptions and inputs	218 days?	Tue 01/06/21	Thu 31/03/22	
113	Training and handover	65 days?	Fri 01/04/22	Thu 30/06/22	
114	**Network based PV**	1044 days?	Mon 02/04/18	Thu 31/03/22	
115	Feasibility report on sites suitable for network PV installation.	325 days?	Mon 02/04/18	Fri 28/06/19	
116	Measure and analyse changes to the average and peak demand at transformer	720 days?	Mon 01/04/19	Fri 31/12/21	
117	Report on the benefits of network based PV	284 days?	Mon 01/03/21	Thu 31/03/22	
118	**Customer side of meter PV**	1044 days?	Mon 02/04/18	Thu 31/03/22	
119	Feasibility report on types suitable for free issue PV including projected benefits	325 days?	Mon 02/04/18	Fri 28/06/19	
120	Report on the network effects of PV deployment on network	284 days?	Mon 01/03/21	Thu 31/03/22	
121					
122	**Update of Ofgems CBA Models**	1109 days?	Mon 02/04/18	Thu 30/06/22	
123	Phase 1: Update Ofgem's CBA model to take account of "Level One" benefits, th	196 days?	Mon 02/04/18	Mon 31/12/18	
124	Engage with the wider industry and other stakeholders to agree upon a preferre	86 days?	Thu 01/11/18	Thu 28/02/19	
125	Phase 2: Update Ofgem's CBA model to take account of "Level Two" benefits, w	457 days?	Tue 01/01/19	Wed 30/09/20	123
126	Engage with the wider industry and other stakeholders to agree upon a preferre	87 days?	Mon 02/09/19	Tue 31/12/19	
127	Phase 3: Regulatory Calibration; benchmarking the newly developed Phase 2 m	456 days?	Thu 01/10/20	Thu 30/06/22	125
128	Engage with the wider industry and other stakeholders to agree upon a preferre	65 days?	Fri 31/12/21	Thu 31/03/22	
129					
130	**Workstream - Technical**	610 days	Mon 02/04/18	Fri 31/07/20	
131	Intervention scoping and analysis	130 days?	Mon 02/04/18	Fri 28/09/18	
132	Procure and purchase substation monitoring equipment	196 days?	Mon 02/04/18	Mon 31/12/18	
133	Install substation monitoring	131 days?	Mon 02/07/18	Mon 31/12/18	
134	Procure and purchase interventions	150 days?	Mon 03/12/18	Fri 28/06/19	
135	Install interventions	263 days?	Mon 01/07/19	Wed 01/07/20	134
136					
137	**Workstream - Learning & Dissemination**	1260 days?	Thu 01/02/18	Wed 30/11/22	
138	**Power Saver Plus Website**	1151 days?	Thu 01/02/18	Thu 30/06/22	
139	Design, build, install, test and commission Power Saver Plus website	107 days?	Thu 01/02/18	Fri 29/06/18	
140	Launch Power Saver Plus website	1 day?	Tue 31/07/18	Tue 31/07/18	
141	Support and maintenance of Power Saver Plus website	1151 days?	Thu 01/02/18	Thu 30/06/22	
142	Create and put in place a publicly available data sharing policy	1 day?	Mon 01/01/18	Mon 01/01/18	
143	**Knowledge sharing events**	1086 days?	Fri 01/06/18	Fri 29/07/22	
144	Knowledge sharing event 2018 - Introduce project	43 days?	Fri 01/06/18	Tue 31/07/18	
145	Knowledge sharing event 2019 - update	43 days?	Mon 03/06/19	Wed 31/07/19	
146	Knowledge sharing event 2020 - update	45 days?	Mon 01/06/20	Fri 31/07/20	
147	Knowledge sharing event 2021 - update	44 days?	Tue 01/06/21	Fri 30/07/21	
148	Knowledge sharing event 2022 - Conclusions	43 days?	Wed 01/06/22	Fri 29/07/22	
149	**Advertorials**	805 days?	Mon 01/10/18	Fri 29/10/21	
150	Advertorial 1 - publicise Power Saver Plus	22 days?	Mon 01/10/18	Tue 30/10/18	
151	Advertorial 2 - publicise progress and learning	23 days?	Tue 01/10/19	Thu 31/10/19	
152	Advertorial 3 - publicise progress and learning	22 days?	Thu 01/10/20	Fri 30/10/20	
153	Advertorial 4 - publicise progress and learning	21 days?	Fri 01/10/21	Fri 29/10/21	
154	**LCNI Conference attendance**	783 days?	Fri 30/11/18	Tue 30/11/21	
155	LCNI conference 2018	1 day?	Fri 30/11/18	Fri 30/11/18	
156	LCNI conference 2019	1 day?	Fri 29/11/19	Fri 29/11/19	
157	LCNI conference 2020	1 day?	Mon 30/11/20	Mon 30/11/20	
158	LCNI conference 2021	1 day?	Tue 30/11/21	Tue 30/11/21	
159	LCNI conference 2022	1 day?	Wed 30/11/22	Wed 30/11/22	
160	**Ofgem annual reports**	785 days?	Mon 31/12/18	Fri 31/12/21	
161	Project progress report 2018	1 day?	Mon 31/12/18	Mon 31/12/18	
162	Project progress report 2019	1 day?	Tue 31/12/19	Tue 31/12/19	
163	Project progress report 2020	1 day?	Thu 31/12/20	Thu 31/12/20	
164	Project progress report 2021	1 day?	Fri 31/12/21	Fri 31/12/21	
165	**Internal learning and dissemination**	1174 days?	Mon 01/01/18	Thu 30/06/22	
166	Social media updates	1174 days?	Mon 01/01/18	Thu 30/06/22	
167	Connect e newsletter and newswire magazine	23 days?	Mon 01/01/18	Wed 31/01/18	
168	Connect e newsletter and newswire magazine	22 days?	Mon 01/04/19	Tue 30/04/19	
169	Connect e newsletter and newswire magazine	22 days?	Wed 01/04/20	Thu 30/04/20	
170	Connect e newsletter and newswire magazine	22 days?	Thu 01/04/21	Fri 30/04/21	
171	Connect e newsletter and newswire magazine	21 days?	Fri 01/04/22	Fri 29/04/22	
172					
173	**Phase 3) Close down and BAU transition**	66 days?	Fri 01/07/22	Fri 30/09/22	
174	Development of close down report	66 days?	Fri 01/07/22	Fri 30/09/22	
175	Peer review of close down report	23 days?	Mon 01/08/22	Wed 31/08/22	
176	Finalise and publish Power Saver Plus close down report	1 day?	Fri 30/09/22	Fri 30/09/22	
177	A report from an independent third party that verifies whether the Project Deliver	66 days?	Fri 01/07/22	Fri 30/09/22	
178	A report to assess the relative merits of suppliers and distribution companies be	456 days?	Thu 01/10/20	Thu 30/06/22	



Project: Power Saver Plus Project Plan
Date: Tue 17/10/17

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Appendix H: Risks and Issues Register

The risk model employed by Electricity North West in the delivery of Network Innovation Competition projects looks at risks in much the same holistic manner as the proven risk model employed at a corporate level. However, using previous experience, the risk and issues register has been refined to better reflect the increased significance of impacts at a project level. In this model, risk impact areas have been categorised into time, cost and scope/quality which are given a score of 1 to 5 along with the likelihood of occurrence. The resulting product of these two ratings is used to score and rank the risks on the project. The risk model enables the determination of an 'uncontrolled' risk score. However, if control measures are applied, aimed at reducing the hazard and/or mitigating the risk, it should be possible to produce a controlled risk score that is lower than the uncontrolled risk. The format of our Network Innovation Competition risk scoring matrix is below.

Risk impact descriptors

RISK AREA	1	2	3	4	5
	Negligible	Minor	Moderate	Significant	Serious
Time	There will be no impact on deliverables. No re-planning necessary	Any delays are likely to be small ie <one week and manageable. Minor re-planning necessary	Some delays likely to project/ programme milestones, but the overall project/programme delivery date will not be affected. An element of re-planning will be necessary	There is likely to be a delay which causes the overall project/programme delivery end-date to slip. Significant re-planning will be essential	There is likely to be a delay which causes the overall project/programme delivery end-date to slip. Serious re-planning will be essential
Cost	£0	<£10k	<£20k	<£50k	>£50k
Scope / Quality	There will be no impact on the overall quality of the deliverables in the project/programme. All requirements will still be met	There will be negligible impact (if any), on the overall quality of the deliverables in the project/programme. Most, if not all requirements will still be met	Some requirements will not be met, or a small number of business process(es) will need to be modified to accommodate shortcomings in the delivery	A significant number of requirements will not be met, or business process(es) will need to be modified to accommodate shortcomings in the delivery	Major requirements, key to the success of the delivery are not likely to be delivered as planned

Risk probability descriptors

5	Almost certain	>80%
4	Likely	60-80%
3	Moderate	30-60%
2	Low	10–30%
1	Rare	<10%

Risk score

Impact						
	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Probability				

The following potential risks have been identified. These risks are based on the scoring matrix set out above and linked to the project phase or workstream in which they will occur.

Project Phase	Description (Delivery risk category)	Probability Score	Impact Score	Mitigating Action / Contingency Action	Revised Probability Score	Revised Impact Score
Mobilisation	There is a risk that the project partners are not able to mobilise their resources in time because of other commitments leading to a delay in achieving potential milestones which could have a project reputational and financial repercussion.	3	5	Suitable partnership agreements that ensure collaborative working, value for customers' money and achievement of learning objectives in a timely manner have been identified for all partners. A project initiation document will be issued to project partners to ensure all parties are ready. *Contingency: Electricity North West will seek new partners should existing partners fail to mobilise.*	1	4
Technical	There is a risk that the lead time for delivery of the substation monitoring equipment may lead to a delay in the installation of this technology.	3	5	Project plan specifies that a purchase order will be raised to procure the monitoring equipment allowing the partner to begin manufacture. *Contingency: Flexibility is built into the installation programme with a phased installation plan starting in July 2018 and to be completed by December 2018.*	2	4
Technical	There is a risk that installation of the monitoring equipment or configuration of the data communication will overrun leading to a delayed start on the trial.	3	5	Regular progress meetings/reports to track progress against the plan. We will commit additional operational resource should any delays occur to the installation, testing and commissioning programme. *Contingency: Flexibility is built into the installation programme with a phased installation plan starting in July 2018 and to be completed by December 2018.*	2	5
Technical	There is a risk that monitoring equipment failure will lead to a requirement for additional resource to attend site to fix or replace.	3	4	Phased rollout of equipment to ensure systems are working properly early before all sites are installed. Some remote monitoring and diagnostics will be possible, eg of performance of the communications and through data validation.	3	2

Project Phase	Description (Delivery risk category)	Probability Score	Impact Score	Mitigating Action / Contingency Action	Revised Probability Score	Revised Impact Score
				Contingency: Additional budget identified for this issue.		
Technical	There is a risk that the lead time for the energy efficiency interventions may lead to a delay in the installation of this intervention and delayed start of the trial.	3	5	During selection, each intervention will be assessed based on a number of characteristics, including deployment issues. This will reveal potential issues. *Contingency: Flexibility is built into the installation programme with a phased installation plan starting in July 2019 and to be completed by July 2020.*	2	2
Trials and analysis	There is a risk that data is lost or corrupted during the project.	3	2	An IT plan will be identified, reviewed and agreed during the project, which includes a data validation, security and back-up plan. *Contingency: Where gaps in data occur, then analysis can be carried out on the remaining data, and where necessary missing data will be simulated.*	1	3
Trials and analysis	There is a risk that advice given to customers as part of the smart meter rollout may have an effect on the results of the trial.	1	1	Due to the smart meter rollout taking place across GB, this will have an impact across the whole trial and not just certain areas. *Contingency: Within the site selection criteria, we will look to track installation of smart meters in the premises of trial participants.*	1	1
Customer	There is a risk that external factors, not directly influenced by the trials or related to PS+, could cause customers to become negative towards Electricity North West or NIC projects.	1	2	The project team will work closely with the corporate communications team to identify any potential issues and formulate targeted communication to proactively minimise any adverse impacts to PS+. *Contingency: We may temporarily halt the trials in that area until our customers are reassured of the benefits of PS+.*	1	2

Project Phase	Description (Delivery risk category)	Probability Score	Impact Score	Mitigating Action / Contingency Action	Revised Probability Score	Revised Impact Score
Customer	There is a risk that customers may deem it unfair if participants are being issued with different energy efficient measures.	1	1	The PS+ project team along with our customer partners will make sure the project and expected benefits are fully explained through their engagement activities set out within the project plan. This risk is also reduced somewhat through clustering customers so that those in very close proximity are allocated to the same type of trial. *Contingency: If participants are unhappy with the energy efficient intervention they have the option to leave the trial. We have allowed for over recruitment in our customer trial numbers.*	1	1
Customer	There is a risk that there may be some confusion among customers due to other ongoing government initiatives. This could lead to customer engagement being adversely affected.	1	2	The PS+ customer engagement plan is both non-intrusive and simple, thus minimising the potential for confusion with other government initiatives. *Contingency: Effective communication and engagement to remove confusion and differentiate the role and activities of Electricity North West and PS+.*	1	1
Customer	There is a risk that the incentives on offer may not encourage customers to participate in the trial, leading to a reduced trial and the results not being robust or representative.	2	2	PS+ will over recruit to avoid not having a robust representative sample of customers. There will be a structured incentive mechanism whereby survey participants receive a higher incentive for the final engagement components. This is transferred learning from other projects and is effective in reducing attrition and maximising learning.	2	1

Project Phase	Description (Delivery risk category)	Probability Score	Impact Score	Mitigating Action / Contingency Action	Revised Probability Score	Revised Impact Score
				Contingency: If there is significant difficulty in identifying a robust customer sample size, then the trial can be implemented with fewer participants. Where gaps in data occur, then analysis can be carried out on the remaining data, and where necessary missing data will be simulated/modelled.		
Customer	A customer engages in the trial and participates in the pre-trial engagement, receives their free intervention and then refuses to participate in the trial. How do we account for these 'lost interventions' in the trial?	3	3	We will make clear to trial participants of their rights and obligations under the trial and have them sign a document outlining the parameters and requirements of the trial. *Contingency: We plan to over recruit to account for attrition and have apportioned an amount of contingency budget to account for this eventuality, should an intervention be 'lost' for any reason during the trial period.*	2	1
Learning	There is a risk that attendance at events may be low due to the number of projects and knowledge dissemination events already taking place.	2	1	We will try where possible to merge dissemination events and choose dissemination media optimised to achieve maximum reach and coverage. Dissemination will also be carried out through multiple communication channels. *Contingency: Interested parties are able to contact the project team for any queries and request additional information.*	1	1

Appendix I: Project Partner and Supplier Details

Name	Type of organisation	Funding provided	Contractual relationship with Electricity North West	Role of project partner	Funding benefits to PS+
BRE Consulting Group	BRE is an independent, research-based consultancy, testing and training organisation, offering expertise in every aspect of the built environment and associated industries.	[redacted]	BRE will be a partner organisation. Terms and conditions that include the NIC default IPR arrangement have been shared and agreed. This will govern the scope and obligations of partner involvement.	• Scoping, design, build, development, testing and evaluation of the Power Saver Tool with user guide • Site selection support • Intervention scoping and analysis	Discount on day rates
Impact Utilities	Impact Utilities, a specialist division within the Impact Research Group, is a full-service market research agency focused on servicing the UK energy, water and travel sectors. Their expertise is in the area of customer engagement, specifically the design, management, analysis and dissemination of research projects.	[redacted]	Impact will be a partner organisation. Terms and conditions that include the NIC default IPR arrangement have been shared and agreed. This will govern the scope and obligations of partner involvement.	• Literature review and report • Stakeholder engagement • Methodology statement, DPS, CEP • Customer engagement set-up (marketing, programme and systems) • Planning the home energy visit, customer engagement – communication, recruitment and support • Customer survey implementation	Discount on day rates

Name	Type of organisation	Funding provided	Contractual relationship with Electricity North West	Role of project partner	Funding benefits to PS+
Delta Energy and Environment (Delta-ee)	Delta-ee is a research and consulting company that provides its clients with information, analysis, insight and advice in emerging distributed energy markets.	[redacted]	Delta-ee will be a partner organisation. Terms and conditions that include the NIC default IPR arrangement have been shared and agreed. This will govern the scope and obligations of partner involvement.	• Monitoring trial data analysis • Site selection support • Intervention scoping and analysis • Performance analysis framework report • Performance monitoring reporting (performance of energy efficiency interventions) • Dissemination reporting, key learning from the project	Discount on day rates
The Energy Saving Trust	Energy Saving Trust is a leading and trusted organisation helping people save energy every day. Their experts speak with millions of householders every year, deliver first class programmes for governments and provide consultancy to UK businesses and international companies. All that they do is underpinned by their pioneering world-renowned research. EST is independent and impartial so the advice they give is all about helping customers.	[redacted]	Energy Saving Trust will be a partner organisation. Terms and conditions that include the NIC default IPR arrangement have been shared and agreed. This will govern the scope and obligations of partner involvement.	• Customer segmentation and substation typologies • Development of an integrated in-home and online advice tool • Peer reviewer	A range of other resources, studies and existing tools

Name	Type of organisation	Funding provided	Contractual relationship with Electricity North West	Role of project partner	Funding benefits to PS+
University of Salford	The University of Salford is a known expert in the built environment. The Applied Buildings and Energy Research Group is a multi-disciplinary research unit concerned with the energy efficiency and wider performance of buildings. They have a strong focus around domestic properties and the unit is home to the Salford Energy House, a whole house test facility in a climate controlled chamber.	[redacted]	University of Salford will be a partner organisation. Terms and conditions that include the NIC default IPR arrangement have been shared and agreed. This will govern the scope and obligations of partner involvement.	• Salford University will be the lead consultant for the PS+ heating trial • They bring a diverse range of experience to the field trials and analysis of the real world impact of new and traditional heating technologies	The University of Salford will provide three weeks' use of the Salford Energy House
NERA Economic Consulting	NERA Economic Consulting is a global firm of experts dedicated to applying economic, finance, and quantitative principles to complex business and legal challenges.	[redacted]	NERA will be a partner organisation. Terms and conditions that include the NIC default IPR arrangement have been shared and agreed. This will govern the scope and obligations of partner involvement.	• NERA will be the lead consultant for the revised CBA modelling under PS+ • NERA bring a breadth of experience in CBA and an in-depth knowledge of the RIIO regulatory regime • They have extensive experience in the design, support and peer review of CBA models for electricity, gas and water network operators across various price controls and assisting DNOs in the preparation of their forecasts and business plans	A range of other resources, studies, reports and existing tools

Institute for Public Policy Research North

Steve Cox
Electricity North West
304 Bridgewater Place
Birchwood Park
Warrington WA3 6XG

3 August 2017

Dear Steve,

LETTER OF SUPPORT FOR ELECTRICITY NORTH WEST LIMITED
NIC PROJECT 'Power Saver Plus'

IPPR North has been delighted to hear about the innovative project, Power Saver Plus, that Electricity North West are proposing for the Network Innovation Competition.

Having worked with Electricity North West in the development of a Northern Energy Strategy, we understand that this project will aim to improve the affordability and sustainability of the electricity network and provide additional cost savings for customers by demonstrating that energy efficiency for homes and small businesses can be delivered at scale by distribution network companies. We recognise that this approach has the potential to deliver direct benefits to the economy and the environment, as well as having a potential impact on levels of fuel poverty in our region.

In accordance with our Northern Energy Strategy, this focus on energy efficiency will help drive significant improvements in carbon emissions and can support our local energy agenda. We look forward to working with Electricity North West during the project to explore further opportunities for collaboration and shared learning.

Yours sincerely,

Edward R Cox

Ed Cox
Director, IPPR North

The progressive policy think tank

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@IPPRNorth

IPPR North
13th Floor, City Tower, Piccadilly Plaza, Manchester M1 4BT

GMCA GREATER MANCHESTER COMBINED AUTHORITY

2nd August 2017

Steve Cox
OFGEM

Dear Steve,

LETTER OF SUPPORT FOR ELECTRICITY NORTH WEST LIMITED - NIC PROJECT 'Power Saver Plus'

Greater Manchester Combined Authority has been delighted to hear about the innovative project, Power Saver Plus, that Electricity North West are proposing for the Network Innovation Competition.

We understand that this project will aim to improve the affordability and sustainability of the electricity network and provide additional cost savings for customers by demonstrating that energy efficiency for homes and small businesses can be delivered at scale by distribution network companies. We recognise that this approach has the potential to deliver direct benefits to the economy and the environment, as well as having a potential impact on levels of fuel poverty in our region.

We understand that using energy efficiency as an alternative to network reinforcement will enable network operators to reduce network load and avoid the cost and disruption associated with reinforcement works.

In our view, this focus on energy efficiency will help drive significant improvements in carbon emissions and can support our local energy agenda. We look forward to working with Electricity North West during the project to explore further opportunities for collaboration and shared learning.

Yours faithfully

Eamonn Boylan
Chief Executive

Scottish & Southern Electricity Networks

POWER CUT? CALL 105

North of Scotland 0800 300 999

Central Southern England 0800 072 7282

Electricity North West
Technology House
Salford
Manchester
M6 6AP

27 July 2017

Dear Sir/Madam

Scottish and Southern Electricity Networks and Electricity North West Limited have openly discussed Solent Achieving Value from Efficiency (SAVE) and the areas where the two projects complement one another. It is understood that Electricity North West wish to avoid any duplication, building on previous work and ensure best value to our customers. In support, Scottish and Southern Electricity Networks endorse this approach and shall collaborate where appropriate.

Scottish and Southern Electricity Networks recognise there is more work to be done in the area of domestic energy efficiency and that the Power Saver Plus project seeks to unlock further savings. The two projects shall overlap in 2018, thus there is an opportunity for both parties to directly share learning, influencing the engagement phase of Power Saver Plus and final trials within the SAVE project. The two DNOs aim to continue direct knowledge share throughout the lifetime of both projects and will look for combined dissemination opportunities, assisting business as usual role outs and the unlocking of value to our customers.

Yours Sincerely

Stewart Reid
Head of DSO and Innovation

E: Stewart.A.Reid@sse.com

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Mr Tom Law
Discretionary Funding Manager
Engineering and Technical Directorate
Electricity North West Limited
Hartington Road
Preston PR1 8AF

03 August 2017

Dear Tom

Network Innovation Competition proposal "Power Saver Plus" by Electricity North West Limited

The purpose of this letter is to formally set out BRE's support for Electricity North West's Network Innovation Competition proposal "Power Saver Plus".

BRE is the UK's leading building science centre. We are an impartial, research-based consultancy, testing and training organisation, offering expertise in every aspect of the built environment and associated industries. We help clients create better, safer and more sustainable products, buildings, communities and businesses - and we support the innovation needed to achieve this.

BRE are particularly interested in the principle of DNO led energy efficiency initiatives and strongly believe that such an approach can offer significant benefits strategically aligned to not only assisting delivery of the UK's carbon reduction commitments but importantly doing so whilst simultaneously addressing wider energy system issues as the UK moves to a low carbon future. The proposed Power Saver Plus research aims to support customers reduce their energy consumption whilst addressing how suitably targeted energy efficiency can impact positively in a wider societal sense e.g. by providing superior electricity system benefits such as freeing up capacity on the electrical network, reducing network losses and reducing reliance on high-carbon generation.

BRE is participating in this research as we see significant research need and opportunity for the UK built environment and network sectors in the innovative area of DNO led customer energy efficiency. As a result we warmly welcome the opportunity to contribute to this Electricity North West Limited innovation research project in a variety of capacities, but with a particular focus on supporting the ongoing legacy of the project by developing appropriate tools and methodologies to enable UK DNOs to identify the most appropriate and cost effective energy efficiency interventions whilst taking due consideration for critical built environment factors including the specific location, building type, tenure, age and condition, customer type and socio-economic factors.

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The proposed research fits well with BRE's strategic objectives of helping government, industry and business to meet the challenges of our evolving built environment: the need to transition to a low carbon economy being a key concern but also doing so whilst taking due consideration for building occupants, particularly householders, and ensuring that proposed solutions are appropriate to property and customer types as only by taking cognisance of human need can we deliver the project goal of lasting long term environmental benefits.

In July 2015, the UK Government commissioned an 'Independent Review of Consumer Advice, Protection, Standards and Enforcement' for home energy efficiency and renewable energy measures in the United Kingdom. This was published in December 2016 under the title Each Home Counts and focuses squarely on getting a fair deal for the consumer.

As part of the recommendations of the report, there are wide ranging changes that are required to deliver the assurance and peace of mind for the consumers that the right product, for the right reason to the right standard will be recommended, following on the measures will then be installed by a competent work force with right knowledge, skills and application, and finally if failure does occur, a clear and single mechanism for redress is available.

BRE are pleased to see a proposal such as this emerge in the short space of time since its publication.

We see the integration of buildings, and their energy systems, within future smart energy networks as critical to the development of the UK's energy supply in the future. The proposed research would address longstanding questions relating to the relationship between customer needs and alleviation of pressure on the evolving grid.

To this end BRE is delighted to support the proposal and our potential future involvement. In addition, through our research, consultancy and knowledge dissemination events and networks, we will endeavour to share learnings with a wide audience and help ensure the future adoption of the research learning and outputs in both the built environment and electricity distribution network sectors.

Yours sincerely

Rufus Logan
Group Director – BRE Scotland, Wales and National Solar Centre

cc **Dr Peter Bonfield, OBE, FREng**
Chief Executive, Building Research Establishment

Energy Saving Trust
21 Dartmouth Street
London SW1H 9BP

energysavingtrust.org.uk
020 7222 0101 phone
020 7654 2444 fax

PRIVATE & CONFIDENTIAL

Tom Law
Project Manager Power Saver Plus
Electricity North West limited
304 Bridgewater Place
Birchwood Park
Warrington
WA3 6XG

20th July 2017

LETTER OF SUPPORT FOR ELECTRICITY NORTH WEST LIMITED – NIC PROJECT 'POWER SAVER PLUS'

The Energy Saving Trust is delighted to have been selected as a partner to work with Electricity North West on the Power Saver Plus project.

The Power Saver Plus project will be a highly valuable project to advance our understanding of the role that Distribution Network Operators can play in the reduction of energy use within their local communities. The project will provide a robust evidence base as to the impact of different packages of energy efficiency and technology intervention measures in homes and businesses; with a focus on the measureable impact of these programmes on energy demand at the sub-station level. The project has been designed so that the evidence base will be relevant to every DNO and can be used and built upon by other DNOs to assess the merits of energy efficiency alongside other capital investment programmes.

The Energy Saving Trust's expertise lies in how customers can be engaged and encouraged to reduce their energy use, through adopting energy efficiency measures and technology as well as energy saving behaviours. We provide the consumer insight that is essential for the successful delivery of policy and programmes. Likewise, we communicate project aims and objectives to customers in ways that are meaningful to them. We look forward to working with Electricity North West as a consumer interface to help the project achieve maximum impact.

Electricity North West has put together a strong consortium of partners to work on this project and we look forward to working with Electricity North West and the other partners on this important and innovative project.

Yours sincerely,

Philip Sellwood

Chief Executive, Energy Saving Trust

Energy Saving Trust Foundation
Registered in England and Wales No.07703610
Charity No.1144106

Registered Office:
21 Dartmouth Street
London SW1H 9BP
VAT No.123 3838 27

DELTA
Energy & Environment

PRIVATE & CONFIDENTIAL

Steve Cox
Director of Engineering
Electricity North West Limited
304 Bridgewater Place
Birchwood Park
Warrington
WA3 6XG

Dear Steve,

LETTER OF SUPPORT FOR ELECTRICITY NORTH WEST LIMITED'S NIC PROJECT: POWER SAVER PLUS

Delta-ee is delighted to have been selected as a partner to work with Electricity North West on the Power Saver Plus project.

By exploring the impact of a targeted deployment of energy efficient measures in buildings across a distribution network, Power Saver Plus will add valuable insight into the alternative options that DNOs in the UK have for network reinforcement. By targeting energy efficiency at buildings in constrained areas of the network, many network upgrades / reinforcements will likely be deferred or avoided entirely – increasing the value of energy efficiency deployments. And of course, by improving the energy efficiency of buildings, less electricity will need to be generated, network losses will be reduced, and energy bills for customers will fall, bringing added benefit to customers.

This is an exciting and innovative project with real potential to impact the current network reinforcement approach of Electricity North West and the other UK DNOs. Electricity North West will potentially be armed with more cost effective approaches to freeing up capacity on its network (compared to conventional approaches) and could avoid the need to reinforce parts of its network. Learnings from this project can of course by replicated by other DNOs, adding energy efficiency to their toolkit for network planning, benefiting the whole of Great Britain.

Delta-ee has significant capability in heating technology and energy efficiency performance in buildings, and has extensive understanding of customer attitudes and behaviours towards energy efficiency (including drivers of behavioural change, impact of controls / smart devices) – and can support Electricity North West in testing the impact on a range of energy efficient measures across its network. Having previously worked with Electricity North West (and other DNOs) on network innovation projects, Delta-ee has experience in supporting DNOs in delivering successful innovation projects.

We look forward to working closely with Electricity North West and the other Power Saver Plus project partners on this project. In the event Electricity North West's bid for funding is successful and is awarded a contract to support the Power Saver Plus project, Delta-ee will participate under sub-agreement terms to be agreed with Electricity North West at a later date.

Yours sincerely,

Jon Slowe
Director

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Delta Energy & Environment Ltd | Registered in Scotland: No SC259964
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Impact Research Ltd
3 The Quintet
Churchfield Road
Walton-On-Thames
Surrey

Steve Cox
Engineering & Technical Director
Electricity North West Limited
304 Bridgewater Place
Birchwood Park
Warrington
WA3 6XG

14 July 2017

Dear Steve,

LETTER OF SUPPORT FOR ELECTICITY NORTH WEST LIMITED - NIC PROJECT 'PSP'

Impact Research is delighted to have been selected to be part of the consortium of partners working in collaboration with Electricity North West on the Power Saver Plus project.

Impact Research is an independent market research agency specialising in obtaining and analysing customer and stakeholder feedback.

The project seeks to demonstrate how a DNO-led targeted customer energy efficiency programme could effectively deliver reduced electricity bills for customers, reduced distribution network costs and achieve Carbon Plan commitments. In freeing up capacity on the electricity network and reducing the energy bills of network customers, the project will allow for increased adoption of low carbon technologies.

This is an exciting and innovative project with real potential to drive sustainable networks.

Impact Research has a strong track record in the design, management, analysis and dissemination of innovation funded customer engagement activities. We pride ourselves on the rigour of our research methodologies, our sector expertise and the smart application of customised techniques.

Our extensive accumulated project learning of how to engage with customers about behaviour change will aid us in developing multi-channel engagement and education programmes to generate project awareness and recruit participating customers into the project.

We are fully committed to achieving the project success criteria and I have full confidence in the team at Impact Research to deliver a high quality, robust and innovative project.

Yours sincerely,

Michael Brainch
Managing Director

School of the Built Environment
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Thursday, 13th July, 2017

Dear Steve,

LETTER OF SUPPORT FOR ENW – NIC Power Saver Plus

The University of Salford Applied Buildings and Energy Research Group are pleased to lend support as a project partner to the ENW Power Saver Plus Proposal.

The University of Salford will engage with the project through field monitoring and the use of the Salford Energy House, to get a better understanding of electricity consumption to deliver thermal comfort and the implications this has.

ABERG have worked as part of the Greater Manchester Low Carbon Buildings Group and has undertaken large scale field trials for both public sector, including BEIS, and private sector partners. The Salford Energy house has been used to provide evidence for a wide range of ECO style interventions including insulation and heating controls, for which we provided evidence for the ECO consultation. We feel this experience will bring a positive contribution to the project.

Yours Sincerely

Professor Will Swan
Associate Head of School
Head of Applied Buildings and Energy Research Group

Appendix K: Glossary

Term	Description
Achilles Utilities Vendor Database	Supplier management community for the UK utilities industry
ACORN	ACORN is a powerful consumer classification that segments the UK population. By analysing demographic data, social factors, population and consumer behaviour, it provides precise information and an understanding of different types of people. Acorn provides valuable consumer insight helping you target, acquire and develop profitable customer relationships and improve service delivery
BEIS	The department for Business, Energy & Industrial Strategy brings together responsibilities for business, industrial strategy, science, innovation, energy, and climate change
Capacity	The amount of power that can be delivered by an asset
Carbon Plan	The Carbon Plan sets out how the UK will achieve decarbonisation within the framework of our energy policy to make the transition to a low carbon economy while maintaining energy security, and minimising costs to consumers, particularly those in poorer households
Citizens Advice	Aim to provide the advice people need for the problems they face and improve the policies and practices that affect people's lives
Committee for Climate Change (CCC)	Independent advisor to government on building a low carbon economy and preparing for climate change
Cost benefit analysis (CBA) model	A model which takes a systematic approach to estimating the strengths and weaknesses of alternative options
Demand	The amount of electrical energy being consumed at any given time
Distribution network operator (DNO)	The owner and/or operator of an electricity distribution system and associated assets
Distribution network	Any of the electric lines, cables, plant and equipment included within the licensee's low voltage distribution system
Diversity	A factor which is applied to demands to take into account that not all connected demands are operating at the same time or at their maximum rating
Electric vehicle (EV)	A vehicle which uses one or more electric motors or traction motors for propulsion
Energy Company Obligation (ECO) scheme	The Energy Company Obligation (ECO) is a government energy efficiency scheme in Great Britain to help reduce carbon emissions and tackle fuel poverty
Energy Networks Association (ENA)	ENA is the industry body funded by GB electricity transmission and distribution licence holders and gas transporter licence holders. It lobbies on common issues in the operating environment, both at domestic and European levels, and provides technical services for the benefit of members
Energy performance certificate (EPC)	An EPC gives a property an energy efficiency rating from A (most efficient) to G (least efficient) and is valid for ten years
Expression of interest (EoI)	A invitation to express an interest in providing services or products

Term	Description
Feed in tariff (FiT)	A UK Government scheme designed to encourage uptake of a range of small-scale renewable and low carbon electricity generation technologies
Heat pump (HP)	A device that provides heat energy from a source of heat to a selected destination, by moving thermal energy opposite to the direction of spontaneous heat flow
IDNO	Independent distribution network operators develop, operate and maintain local electricity distribution networks
IET	The Institution of Engineering and Technology
Innovation Funding Incentive (IFI)	Scheme established under previous price control settlements. The IFI is intended to encourage licensees to invest in appropriate research and development activities that are designed to enhance the technical development of networks and to deliver value (ie financial, supply quality, environmental, safety) to end customers
Intended nationally determined contribution (INDC)	This is the phrase that countries are using to describe the climate pledges that they will make ahead of the UN negotiations in Paris later this year
Light-emitting diode (LED)	A semiconductor diode that emits light when conducting current and is used in electronic displays, indoor and outdoor lighting, etc
Low Carbon Networks Fund (LCN Fund)	Funding to encourage the DNOs to innovate to deliver the networks we will need for a low carbon economy
Low carbon technology (LCT)	A type of technology which operates with substantially fewer carbon emissions than traditional equivalent
Low voltage (LV)	This refers to voltages of1kV and below
NPV	Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows
Reinforcement	Network development to relieve an existing network constraint or facilitate new load growth
RfI	Request for information
RfP	Request for proposal
RIIO-ED1	Electricity Distribution Price Control that will run from 2015-2023
RIIO-ED2	Electricity Distribution Price Control that will run from 2023-2031
Secondary network	Assets including cables, transformers and switchgear that carry electricity from the higher voltage network equipment and distribute it to homes and properties at 240v
Smart meter	Next generation electricity meters offering a range of intelligent functions
Solar photovoltaic (PV)	Solar cells, also called photovoltaic (PV) cells by scientists, convert sunlight directly into electricity. PV gets its name from the process of converting light (photons) to electricity (voltage), which is called the PV effect
Substation	A point on the network where voltage transformation occurs
Technology readiness level (TRL)	Method of assessing and defining maturity of technology
Transformer	Device that changes the network voltage without changing frequency
WEET	Westminster Energy, Environment & Transport