LCNF Tier 2 SDRC 8.1

PROJECT CLOSEDOWN REPORT

SAVE

Solent Achieving Value from Efficiency

Scottish & Southern Electricity Networks

Solent Achieving Value from Efficiency

Solent Achieving Value through Efficiency (SAVE) is an Ofgem funded project run by Scottish and Southern Electricity Networks (SSEN) and partnered by the University of Southampton (UoS), DNV GL and Neighbourhood Economics (NEL). The innovative programme evaluates the potential for domestic customers to actively participate in improving the resilience of electricity distribution networks and thereby defer the need for traditional reinforcement. The government has forecasted an increase in electricity demand of 60% by 2050 meaning peak demand is likely to grow to six times higher than what the network was designed for.

Scottish and Southern Electricity Networks (SSEN) is the new trading name of Scottish and Southern Energy Power Distribution (SSEPD), the parent company of Southern Electricity Power Distribution (SEPD), Scottish Hydro Electricity Power Distribution (SHEPD) and Scottish Hydro Electricity Transmission. SEPD remains the contracted delivery body for this LCNF Project.

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Acronyms

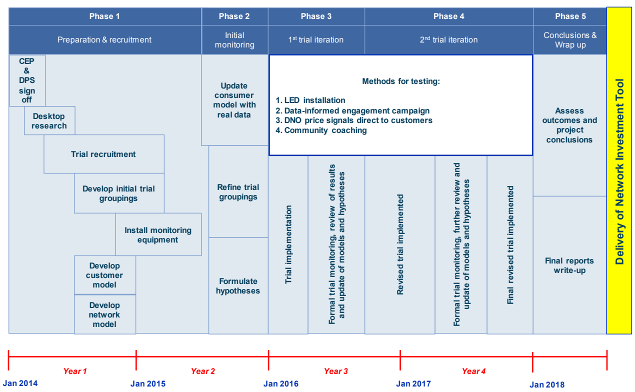
ACE	Activating Community Engagement
BaU	Business as Usual
BMG	Bostock Marketing Group
CAS	Citizens Advice Scotland
CEC	Community Energy Coaching
CfE	Call for Evidence
CI	Census Interface
CLNR	Customer Led Network Revolution
CM	Customer Model
CR	Change Request (often followed by a number based upon the CR being referenced)
CRM	Customer Relationship Management
DDS	Dedicated Distinctive Strategy
DDSR	Domestic Demand Side Response
DPS	Data Protection Strategy
DNO	Distribution Network Operator
DSO	Distribution System Operation
ENW	Electricity North West
E E	Energy Efficiency
ELT	Extended Leadership Team
EST	Energy Saving Trust
EV	Electric Vehicle
FES	Future Energy Scenario
HA	Housing Association
HP	Heat Pump
IPR	Intellectual Property Rights
JIT	Just in Time
LCL	Low Carbon London
LCNI	Low Carbon Networks and Innovation
LCT	Low Carbon Technology
LSOA	Lower Super Output Area
MD I	Maximum Demand Indicator
MINDSPACE	Messenger, Incentives, Norms, Defaults, Salience, Priming, Affect, Commitments, Ego.
NEA	National Energy Action
NEL	Neighbourhood Economics
NIT	Network Investment Tool
NM	Network Model
NPG	Northern Power Grid
NTVV	New Thames Valley Vision
OA	Output Area
p.a	per annum
PeD	Price Elasticity of Demand
PM	Pricing Model
PPRB	Project Partner Review Board
PPR	Post Project Review
PV	Photovoltaic (usually associated with Solar PV)
RCT	Randomised Control Trial
PSR	Priority Service Register
SAVE	Solent Achieving Value from Efficiency
SCMZ	Social Constraint Managed Zone
SGN	Southern Gas Networks
SSEN	Scottish and Southern Electricity Networks
SW	Southern Water
TG	Trial Group
TG1	Trial Group 1 – Control Group
TG2	Trial Group 2 – LED Group
TG3	Trial Group 3 – Price Signals Group
TG4	Trial Group 4 – Data informed Group
TP	Trial Period (often followed by a number based on the time period being referred to)
TU	Time Use
UKDA	UK Data Archive
UKPN	UK Power Networks
UoR	University of Reading
UoS	University of Southampton
WEEE	Waste Electrical and Electronic Equipment Directive
WO	Work Order

PROJECT BACKGROUND

The Solent Achieving Value from Efficiency (SAVE) project ran from January 2014 until June 2019. The project took a robust approach to trialling the extent to which Domestic Demand Side Response (DDSR) measures can be considered as a cost effective, predictable and sustainable tool for managing peak demand as an alternative to network reinforcement.

The project engaged over 8000 domestic customers with measures trialled including: deploying energy efficiency technology, innovative engagement approaches to encourage demand reduction, offering a financial incentive to reduce demand and coaching a community to support both social and network priorities. Initiatives were trialled over three distinct trial phases and were analysed using data from over 4,000 household monitors in a randomised control trial (RCT) design and nearly 100 feeder level monitors covering a further 4,000+ dwellings. Figure 1 below provides an overview of SAVE's 5 phases of delivery.

Figure 1: Project Phasing Diagram



The project was based in the Solent and surrounding area in the South of England, which can be assumed to be representative of much of the UK and where economic growth alongside electrification of transport is highlighting challenges for the network.

The project has worked with partners at the University of Southampton (UoS) to implement the Randomised Control Trial (RCT) phase of SAVE. This has ensured statistical rigour has been at the forefront of the SAVE Project, providing evidence of the extent to which results can be generalised and scaled as well as ensuring future replicability.

Project partners DNV GL and Neighbourhood Economics have provided expert insight into trial design and management throughout the projects three trial phases. This has ensured methods tested built upon industry best practise, theoretical models and (inter)national learning.

Outputs from the SAVE project have been built into a suite of models, collectively termed the Network Investment Tool (NIT). The NIT provides GB Distribution Network Operators (DNOs) the ability to assess a particular network's suitability for demand management through DDSR and allows for informed investment choices to be made between using such measures as opposed to traditional measures and "smart" solutions.

The project has provided a commercial toolbox detailing costs and benefits to DNO's, customers and government through delivery of DDSR. Linking SAVE's objectives to the direction outlined within the governments carbon plan [5] has facilitated joined up thinking in the project's recommendations and blueprints for Business as Usual (BaU) delivery.

SCOPE AND OBJECTIVES

The SAVE project has achieved its key aim to produce a network investment tool that allows DNOs to assess and select the most cost-efficient methodologies for managing a network constraint.

Over and above this, the project has evidenced to both government and industry the delivery mechanisms and revenue streams that energy efficiency can support alongside other forms of DDSR. This is feeding directly into the structure of flexibility markets, political decision making and savings in customer bills.

The project's met its eight core objectives which were to research and build evidence-based learning by:

1. Creating hypotheses of anticipated effect of energy efficiency measures (via commercial, technical and engagement methods)
2. Monitoring the effect of energy efficiency measures on electricity consumption across a range of customers
3. Analysing the effect and attempting to improve the second and third iterations
4. Evaluating the cost efficiency of each measure
5. Producing a customer model revealing customer receptiveness to measures
6. Producing a network model revealing modelled network impact from measures
7. Producing a network investment tool for DNOs
8. Producing recommendations for regulatory and incentives models that DNOs may adopt via RIIO

Objectives 1-4

Table 1 below shows each of SAVE's methods, outcomes per trial period and most cost-effective methods of deployment which are detailed throughout SDRC 8.3 (LED Lighting Trials), SDRC 8.4 and 8.7 (Data Informed and Price Signal Trials) and SDRC 8.8 (Community Energy Coaching Trials).

Details on the specificities of each trial period and how outcomes may be deployed are detailed throughout this report (it is important to consider reliability, longevity, trial application/ statistical rigour applied to different trials and social benefits).

Table 1: Overview of SAVE interventions[1]

Method	Average Reduction per Household			Cost/ kW (using max reduction)	Deployment Effect
	Trial Period 1	Trial Period 2	Trial Period 3		
LED lighting	0 W	47 W	N/A	£2,400	Continuous
Data informed Engagement	23 W	21 W	16 W	£29	Event based
Price Signals	21 W	35 W	44 W	£560	Event based (TP1 & 2) Continuous (TP3)
Community Energy Coaching	N/A	N/A	0-140 W[2]	£280-£1,100	Event based

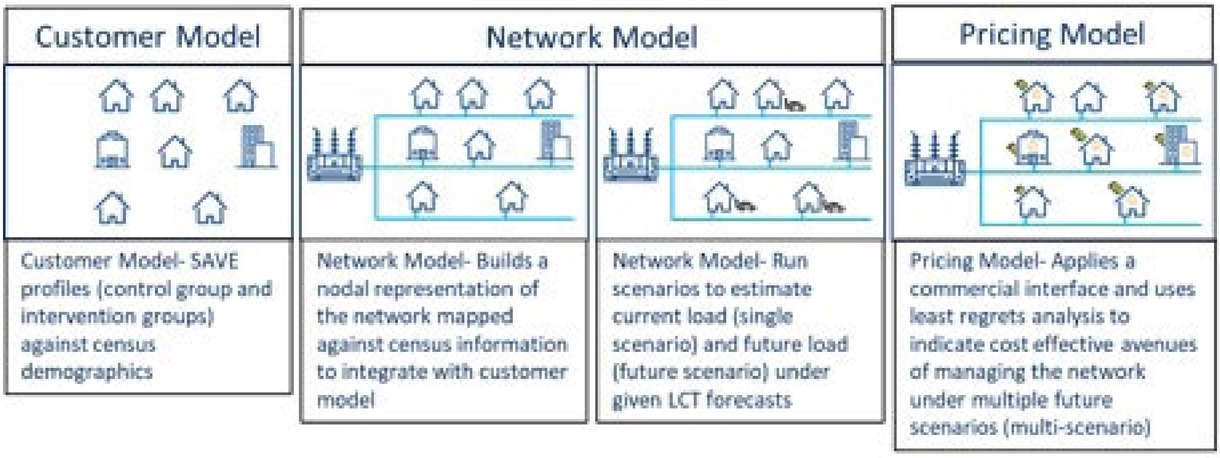
1 For brevity, this report quotes estimated outcomes (treatment effects) as point estimates. Confidence intervals that indicate the uncertainty around these estimates can be found in SDRC 8.3 (LED lighting) and SDRC 8.4 & 8.7 (Data informed and price signals). Deployment Effect refers to the timescales over which the observed peak-hours effects persist. Refer to SDRCs for details.

2 Results from the CEC trials were monitored at feeder level with lower degrees of statistical confidence than other trials, as a result outputs are displayed as a range based on results from representative feeders.

Objectives 5-8

Figure 2 shows a graphical representation of the three models that make up the NIT. Functions of these models are detailed in SDRC's 2.3 (Finalise Customer Model) and SDRC 7.3/8.5 (Finalise Models [Network and Pricing/Incentives]). The integration of each model is discussed in SDRC 8.5/8.6 (Customer, Network and Pricing Model) and the Final NIT is described in SDRC 8.2 (Network investment tool key outcomes report).

Figure 2: Overview of NIT



In order to support delivery of the NIT the project has also produced:

- a regulatory report [4] to look at key governance considerations in SAVE interventions
- an operational report [27] to look at industry processes and how a new software interface can be integrated within industry standards and procedures.

EXECUTIVE SUMMARY

The SAVE project is a £10.3m project, primarily funded by Ofgem's Low Carbon Networks (LCN) Fund. The project aims to assess the use of domestic demand side response (DDSR) measures as an alternative to traditional reinforcement.

The Project involves a cross-section of domestic customers which are representative of much of the UK. Organisations collaborating as partners with Scottish and Southern Electricity Networks (SSEN) to manage and deliver the Project include the University of Southampton (UoS), Future Solent, Neighbourhood Economics Ltd (NEL) and DNV GL. The Project involves approximately 8,000 customers across 4 methods of intervention: deploying LED lighting; using media campaigns linked to the electrical consumption of individual households; adding a financial incentive to these campaigns, (methods 1-3, monitored at household level); and using community energy coaches (method 4, monitored at feeder level).

Outcomes from the projects' trials have been fed into a series of models, collectively termed the Network Investment Tool. A DSO ready software interface to support in more pro-active, smarter and more cost-effective management of LV Networks. The project estimates that learning from SAVE's trials and Ofgem's £8.3m investment could save the UK £1.6bn-4bn in our transition to a low carbon economy, of which up to 1/4 of the benefits could be realised by DNO's.

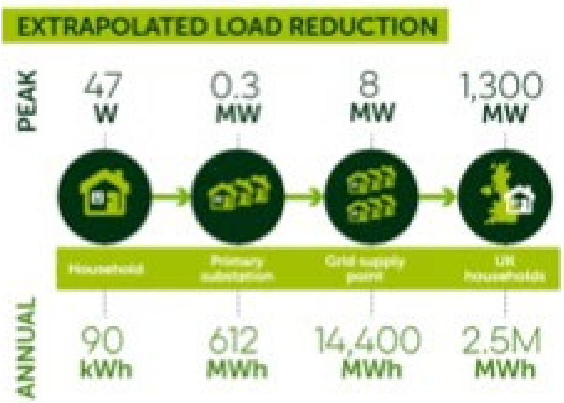
Project Outcomes and Lessons Learned

SAVE's DDSR methods were trialled across three winter periods. Trial methods 1-3 each contained mutually exclusive groups of 1000 monitored domestic customers with a further 1000 customers monitored as a control group as per SAVE's Randomised Control Trial (RCT) design.[3] Trial Method 4 engaged two differing communities (one relatively affluent and rural, the other relatively deprived and urban) each of 1000 households monitored via the network (feeder level). A further two matched 'control' communities (one rural and affluent and one urban and deprived) were also monitored to provide comparative data.

RCT: LED trials

SAVE's LED trials tested an initial 'opt-in' based approach to the uptake of energy efficiency (EE). The trials provided an education campaign and the offer of discounted bulbs through a project website. Whilst 19% of the trial group visited a project website less than 1% procured bulbs. The project team used this learning to build an opposing 'opt-out' approach to EE engagement in the projects second trial period (TP2). The project designed a DNO led approach to LED engagement, which saw over 76% of the trial group have an average of 7 bulbs installed in their homes.

Figure 3: Impact of LED trials



3 SAVE endeavoured to keep statistical rigour and transparency throughout its reporting. Kahneman [7] notes the importance of the method in which data is collected and sample size in ensuring that relationships between cause and effect are not down to chance. A recommendation from the project is that future innovation trials should adhere to a minimum, best-practise, standard of statistical rigour to allow for accurate comparison of project outcomes. See UoS journal article [23].

The maximum observed effects showed a statistically significant[4] 47W (9%) reduction in demand per household across the peak period with an average annual reduction in energy of 90kWh or £15.82 per household. Treatment effects were calculated to be 5% higher on average for vulnerable customers. As can be seen from Figure 3, when scaled across the UK this could result in a peak load reduction of 1.3GW or the same as the generation of a nuclear power station. Average annual savings in energy consumption across the UK would equate to 2.5TWh or over £400 million in annual household energy costs.

Given the success of SAVE's LED trials in TP2 the project did not run a third LED trial. It was determined that running a full trial to engage just 24% of the LED groups population was not replicable or commercially optimal. Instead the team worked with industry to design a new form of price signal trial period that could be facilitated by changing the structure of the previous LED trial group.

RCT: Data informed and Price signal trials

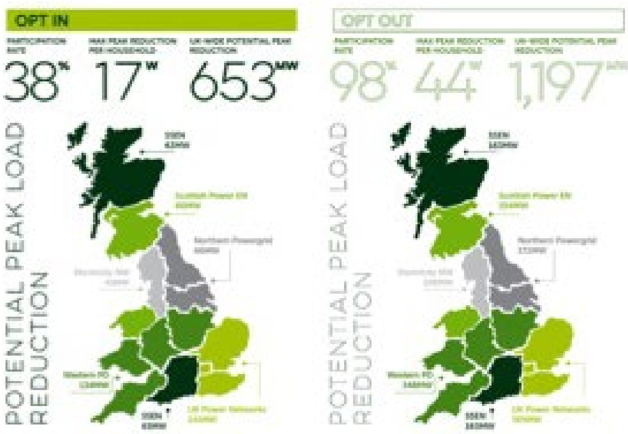
Throughout trial periods 1 and 2 the projects data informed trial group, and price signal trial group followed parallel methodologies. These trial periods were built around event days modelling a critical peak rebate (CPR) pricing structure. All material sent to the two trial groups was mirrored, the only difference being that for 'event-days' the price signal trial group was offered a defined financial incentive whilst the data-informed trial group was not.

The engagement campaigns behind the trials were designed to test behavioural techniques including various forms of 'nudge' techniques i.e. defaults. TP1 created an engagement campaign that provided education through regular updates, delivered through materials featuring two SSEN employees, priming participants before a one-off event day. The event day resulted in a 21W-23W (3.4-3.6%) reduction in peak demand.[5] TP2 built on feedback that engagement was, at times, too regular and was often discarded. As a result, an information pack was sent to participants including branded[6] household 'freebies' (a range of stationary was provided, particularly memorable were sticky notes including tips around shifting demand that could be stuck on appliances). TP2 ran a series of events of different durations, delivered through different mediums and (for the price signal group) with different incentive levels. Load reductions from events were highest for the price signal group who achieved a 44W (7%) reduction in peak load on one event.

However, on average load-reduction was not significantly different between the group that received an incentive and the group that did not. As a result, during events, price signals are unlikely to represent good value for their additional cost compared to data-informed engagement alone.

Within TP3 the project re-designed its engagement approach to test a more enduring price signal. The project created a pricing mechanism termed 'peak-banded pricing' with daily consumption targets for customers to keep below. Both the engagement groups were enrolled onto the 'peak-banded pricing', one opt-in and one opt-out and one onto a final BaU data informed trial (building on learning from the previous trial periods). Results from the 'peak-banded pricing' trials are shown in Figure 4 both when scaled across each DNO and the UK as a whole. This again clearly shows the difference between an opt-in and opt-out methodology with 38% of customers participating in trials when an opt-in approach was deployed and 98% participating when opt-out was deployed. As a result, maximum peak demand reduction per customer across trial groups was higher in the opt-out group at 44W and 17W in the opt-in group. Interestingly however the average financial reward paid to the opt-in group was lower per W of load-reduction and the group was more price inelastic (less responsive to changes in price signals).

Figure 4: Peak Banded Pricing



4 Results were significant at the 90% confidence level (i.e. p < 0.1). Confidence intervals indicating the uncertainty around the estimated treatment effects for the LED trial can be found in SDRC 8.3.

5 Confidence intervals indicating the uncertainty around all estimate treatment effects can be found in SDRC 8.4 & 8.7.

6 The project created an innovative digital character 'Arthur Tate'

Community: Community Energy Coaching trials

The Community Energy Coaching (CEC) trials took an iterative approach to each trial period, first looking to 'embed' a coach within a community, then to 'build' relationships and capacity to change and finally to 'sustain' demand reduction and social cohesion. The CEC trials were much more socially focused than other trials, a selection of learning outcomes include:

- A need for simple and visual energy literacy to facilitate energy consumption changes
- A requirement to 'earn the right' to talk with a community in order to best address change
- Through working with wider stakeholder organisations, the generation of 'stackable' social impacts which could justify cost-effective multi-agency collaboration
- The value of building a local brand through which to engage communities and give a sense of ownership

Alongside this the CEC trials were able to reduce peak demand in a 'Big Switch Off' hour by an average of 10.6% on selected feeders.[7]

Network Investment Tool

Built from the Customer Model (CM), Network Model (NM) and Pricing Model (PM) SAVE's Network Investment Tool (NIT) provides a DNO with three main functions:

- Single Scenario – This provides the DNO with a more granular insight into capacity analysis on a substation, across the day, and hence availability for new connections.
- Future Scenario – By running load-forecasts on the network a DNO can start to understand how low carbon technology (LCT) uptake may affect said network over a 40-year time span. This can highlight to network planners when (specific parts of) their networks may require management (year) as well as at what season and time of the day said constraints are likely to materialise.
- Multi-scenario – The NIT's load-flow engine provides a planning department with the ability to run up to four network scenarios simultaneously to provide a spread of potential future scenarios. By pairing this information with a commercial interface the tool offers three strategies, per scenario, on how to manage the network over time. These strategies compare the cost of: smart, SAVE and traditional reinforcement options as well as the capacity they may offer and the NPV of intervention deferral. Regret analysis is used to highlight to planners which strategy may be best placed to manage the network in the face of future uncertainty and when they are likely to need to intervene in network management.

The outputs of the NIT have shown:

- SAVE interventions can be used to cost-effectively manage thermal constraints on case-study networks deferring reinforcement for up to 2 years (depending on load-growth scenarios).
- When running LCT uptake scenarios through the NIT, certain LCT's may cause peaks in demand to shift outside of the 4pm to 8pm period. (CLNR electric vehicle profiles were noted as a key driver for shifting peak).
- SAVE interventions are most likely to be part of an optimal investment strategy when load-growth is low and the network is heavily loaded. SAVE interventions may also be more effective in areas where electric heating is already present. SAVE interventions are less likely to be part of optimal investment strategies where load growth is high.

Business Integration

Combining learning from across trials SSEN has identified smart and cost-effective ways of deploying DDSR. Working more closely across stakeholders we are scoping initiatives for joint utility rollout of energy and water efficiency and are already combining efforts of social measures. We are stimulating the market to continue to grow this 'stacking' approach and to break-down barriers to entry within flexibility market for SME and local organisations (who may be best placed to deliver DDSR) through our Social Constraint Managed Zones (SCMZs). The project's NIT can be used to both support future SCMZs and pro-actively identify where flexibility is likely to be a cost-effective solution for network reinforcement as a crucial step in the transition to the (Distribution System Operation) DSO market.

7 The full range of estimated changes in demand observed during the CEC trials are detailed in SDRC 8.8.

1

DETAILS OF WORK CARRIED OUT

1.1 RCT trial Customer Recruitment and Engagement

1.1.1 Initial RCT recruitment

The UoS designed SAVE to be structured as an RCT methodology. UoS provided the direction to field team contractors, BMG, to ensure the projects stratified random sampling techniques recruited a representative spread of customers across each trial group (see SDRC 2.2, Section 1.5). The project achieved its recruitment targets on schedule with SDRC 5[8] delivered in June 2015, with 3056 complete installs against an initial target of 2750.

An overview of SAVE's installation of initial monitoring equipment can be found in SDRC 6 which was delivered to schedule in June 2015. The SAVE project then suffered equipment failure detailed in CR2 and Section 4.2. Following this issue, the project successfully transitioned participants, alongside some new recruits, onto the easier to install Navetas Loop devices. Trials started in January 2017 with 3979 clamps installed.

Identification of communities to support the CEC trials is detailed in SDRC 8.8, section 2.

1.1.2 Ongoing RCT engagement

Building on this initial sample, the project installed a further ~ 1000 Loop devices throughout SAVE's lifecycle to maintain the sample size so that overall, a total of 4935 Loop devices were installed in customer properties. With 1060 project withdrawals, the project closed TP3 with 3117 loops[9] having communicated within 30 days and 2834 loops online.[10] In total the project carried out 5340 annual update surveys to refresh occupant data for each household and 3578 time use diaries to support the projects trials.

Initial hypotheses anticipated a 5% p.a. attrition in project participants. In reality this figure proved to be 9.6%, with rates of attrition similar across each trial group. The project encountered additional challenges in equipment communications. Analysis showed that whilst the simple install of the Loop energy monitors eased recruitment, it also meant the kit was easy to un-install. An estimated 65% of communication issues on the project were due to customers disconnecting and forgetting to re-connect their loop. As a result, a significant amount of time and resource was spent maximising data flows through customer contact by Navetas. Navetas produced weekly status reports, analysed by project partners highlighting the scale of issues, estimated causes, ease of fix and repeat issues.

Throughout the course of the project, 3,328 re-engagement letters (on top of annual newsletters sent to all 4000+ SAVE participants, see appendix 1.1.2) were sent to participants to address offline comms, with an estimated success rate of 33.2%.[11] Following letter engagement pro-active phone engagement was carried out and finally the project would carry out phased field visits, combining work with other field exercises and targeting easy/clustered fixes to minimise costs; over 1916 fixes were made either over the phone or at customer properties. For a further breakdown of ongoing trial engagement see SAVE's annual project management reports.

1.1.3 Project Decommission

At project decommission, the project team looked to optimise value for SAVE participants whilst minimising project costs. Given the potential value of the Navetas Loop to customers in continuing to cut energy usage and their bill[12] and that retained ownership offered a more cost-effective solution to removal of kit, the option for retained ownership of Loop was deemed optimal for the project, customers and the UK (in both returned project budget and ongoing energy reduction).

Working to project governance guidelines and industry best practice the project initiated contact via a letter offering either retained ownership of Loop or sending kit back to the project, in pre-paid packaging, for WEEE directive recycling. Retained ownership required a signed consent in a pre-paid envelope to be returned to the project. A tick box was included for customers to agree to be contacted by UoS should a future project be initiated. Further communications then included letter, phone and field visits to ensure best endeavours to engage non-responses. The decommission process started on 28th January 2019 and finished on: 20th May 2019 with 858 kits transferred to participants and 2384 removals/returned kit.

Substation monitors were also removed in January 2019 and stored for future projects to maximise asset value and minimise decommission costs. Personal project data has been deleted in accordance with SAVE's DPS.

8 See SDRC 5 for further details on sampling methodology, recruitment techniques, questionnaire design and outcomes.
9 Navetas loops have the capacity to retain data for 30 days without information, past this point old data begins to be overwritten. 758 customers had comms offline for more than 30 days.
10 Communicating within 24 hours.
11 Letters were sent of varying design to trial and define optimal behavioural techniques drawing on evidence from 'Nudge' expertise. See appendix 1.1.2.
12 Navetas suggest average savings of £250 per household per annum (https://www.loopenergysaver.com/)

1.2 Energy Efficiency Engagement

1.2.1 Scoping

The initial SAVE project bid looked at winter energy demand by end-use in the UK and determined that lighting is responsible for 11.5% of domestic energy consumption and 19% of evening peak demand.[13] While LED bulbs are readily available in the UK, uptake has been slow and the Energy Savings Trust estimated that at the time of drafting the SAVE bid documents there were still 651 million filament bulbs in use in the UK. For these reasons, SAVE focused on LED lightbulbs.

The SAVE project utilised an iterative development approach to allow learnings from each trial period to inform the design and approach of subsequent trial periods. A full overview of these trials is given in SDRC 8.3.

1.2.2 Trial Period 1

SAVE's first LED trial period (TP1) tested the most cost-effective means a DNO might be able to encourage energy efficiency uptake. The project offered education and vouchers (20% off) to incentivise uptake of LED lighting. An overview of material sent out can be found in Appendix 1 of SDRC 8.3.

1.2.3 Trial Period 2

TP1 highlighted a requirement to adapt the project's methodology to achieve a higher LED lighting uptake. The SAVE project did not attempt to send free LED bulbs to customers through the post, as there is no way to guarantee the bulbs are actually installed and not placed in storage, resold or given away. The project settled on a DNO based rollout of LED lights, physically visiting properties to install up to 10 LED light-bulbs free of charge while also removing old-bulbs from the premises. While on site, staff installed the new LED bulbs in the most used areas of the home and aimed to replace the least efficient bulbs.

Before LED installations commenced, all project staff completed a safety training class that addressed risks associated with home visits, bulb removal and installation. Staff were trained to only work on fixtures when they were turned off or otherwise isolated from the power connection. Staff also performed risk assessments on site to identify any other site-specific risks or unusual hazards such as pets, high ceilings or uneven floor surfaces.

TP1 had limited engagement from the LED group, and so the team could not predict interest in the LED installations. The SAVE team conducted a pilot of 100 households to better understand possible uptake rates and approximate quantity and types of LED bulbs required. Fieldwork for the main rollout of LED installations commenced in September 2017 and ended in January 2018. The procedure followed a similar approach to the pilot, with trial participants receiving a letter in the post notifying them of the offer and project staff following up with phone calls or household visits to schedule the LED installation.

1.3 Data informed and Price Signal Engagement

1.3.1 Scoping

Given the project's focus on customer behaviour change, it commenced with a thorough review of customer engagement in both the energy sector and wider industries, in the UK and internationally, to evaluate which measures have been most effective in terms of motivating behavioural change and which have worked less well.[14] This review of global energy efficiency-based projects has found clear evidence that technology alone does not produce the most consistent, sustainable route to permanent energy efficiency. For this reason, the SAVE project investigated the potential of customer education and engagement.

1.3.2 Trial Period 1

The first trial period, TP1, explored how customer engagement techniques could be used to shift electrical consumption out of the peak period. TP1 focused on general education around the peak period and energy efficiency. It introduced the idea of a peak period (16:00 to 20:00) to consumers and explained why the electricity network is sometimes stressed at this time. TP1 asked customers to shift their electricity consumption to outside of this peak period. Note that TG3 and TG4 received the same engagement content with the exception that TG3 also participated in 'event days' where customers were financially incentivised to shift or cut their reduction on certain days.

The engagement campaign started with an informative introductory booklet that asked participants to 'help keep the power flowing'. The booklet introduced two SSEN employees to the participants and explained how they work hard to keep power flowing to consumers. It explained what SSEN does and the basics of how electricity is provided to households. The booklet also posed the question and tagline, 'can it wait 'till after eight?' and provided tips on simple ways to reduce pressure on the network. As a rule, the engagement campaign shared informative and generic messages with participants and sought to facilitate change rather than just simply telling participants to reduce their consumption. The campaign specifically targeted the idea of shifting energy use

13 Based on 'Assessing the Impacts of Low Carbon Technologies on Great Britain Distribution Networks' by Ofgem and 'GB Energy Demand – 2010 and 2025' from Initial Brattle Electricity Demand-side Model. Confirmed by 'Household Electricity Survey: A study of domestic electrical product usage' by Intertek, reference R66141.

14 See SDRC 1, available at https://save-project.co.uk/

behaviours to outside of the peak period, as this was believed to be a new message for consumers, who, as the projects community energy coaching trials evidenced (see SDRC 8.8 Community Energy Coaching[15]), have typically been given simple 'cut energy use' messages.

1.3.3 Trial Period 2

The second trial period, TP2, expanded on the education aspect of TP1 and asked customers to cut their electricity consumption during peak times by providing them with specific electricity savings ideas (as opposed to the 'shift' message in TP1). The first half (October 2017 to December 2017) of TP2 focused on postal engagement as this is an approach currently available to DNOs in their 'business as usual' (BAU) approach. The second half was a digital-only approach with all communications sent to participants through Loop and by email to test lower cost options that may be available in the future.

In this trial period, both TG3 and TG4 participated in 'event days'. Note that TG3 customers were financially incentivised to meet reduction targets while TG4 customers were not offered any monetary incentives. Financial incentive levels were set to test levels that were both representative of the cost of network reinforcement and to test the behavioural psychology of customers at different price levels/delivery mechanisms.

1.3.4 Trial Period 3

The third trial period, TP3, explored a different approach to that of TP1 and TP2, the process behind this decision is discussed in Section 4.3. TP3 introduced the idea of banded price incentives to TG3 and TG4. This trial asked customers to keep their electricity consumption during peak hours below a personalised threshold; they were then paid a small rebate for every hour they were below this target threshold. Customers were directed to an online video that explained the programme.[16] TG3 was offered the price incentives as an opt-in programme while TG4 was automatically enrolled and given the option to opt-out.

Unlike the two earlier trial periods, TP3 also tested engagement approaches with TG2, which had previously been an LED group.[17] Note that TG2 participated in 'event days' like those in the first two trial periods, but without any general education element to test if TG2 customers would respond to the 'event days' even without education about peak times or electricity saving strategies (changes to the trial periods can be visualised though Figure 9). This represented a possible BaU approach for DNOs while also minimising the cost of event days.

1.4 Community Energy Coaching

1.4.1 Scoping

Prior to trial initiation, project partners NEL worked closely with SSEN to define an overarching methodology for community engagement which built on previous projects, NEL expertise and recognised behavioural approaches such as the MINDSPACE model. This is captured within the 'Project Manual' see Appendix 1.4.1.

The project team sought local expertise to identify two opposing communities to test interventions, one relatively deprived (Shirley Warren) and one relatively affluent (Kingsworthy). Towns of similar socio-economic status were also identified as control towns; each area was monitored at feeder level with 98 monitors covering over 4000 households.

1.4.2 Trial Period 1-3

Initial engagement focused on 'embedding' of a community coach and establishment of a defined stakeholder group to 'stack' organisational benefits and both simplify messaging to a community and maximise opportunities. The second trial period aimed to 'build' on this platform, focusing on identifying issues within the community and how the stakeholder group could assist in addressing these and tying them with their own (energy related) messages. Final trials looked to 'sustain' load-reduction through a series of load-reduction challenges across communities and at neighbourhood level.

Key activities across this time are indicated in Figure 5 overleaf and detailed throughout SDRC 8.8.

15 Available at https://save-project.co.uk/
16 Available Vimeo at https://vimeo.com/362014065/857f6b0149
17 See Section 4.3

Figure 5: CEC trial methodology

OVERALL COMMUNITY ENERGY COACHING TRIAL TIMELINE – KEY EVENTS							
2014	**Phase 1 - Start up /Preparation & Recruitment**						
Q1	Project partner and programme familiarisation	Develop detailed work programme	Input into Customer/Stakeholder Engagement Plan	Identify and initiate key stakeholder engagement	Identify criteria for trial area selection		
Q2	Roadshow workshop sessions with all Solent Local Authorities	Agree selection process to identify trial areas & host organisations	Commence best practice review				
Q3	Area selection process initiated	Short list of areas identified for network assessment	Area profiles prepared for shortlisted areas to inform selection process	'Background Review of Good Practice in Community Engagement' submitted to Ofgem	'Less is More' learning visit		
Q4	Trial and control communities agreed	Substation monitoring installed in trial & control areas	Revised SAVE intervention periods agreed & project timeline amended	Ongoing stakeholder engagement & recruitment to planned group			
2015	**Phase 1 & Phase 2 - Initial Monitoring**						
Q1	Stakeholder Group established	Host organisations in place	Coach recruitment process approved	'Outcomes Chain' developed	Multi Agency Project Manual & Local Governance Pack developed	UKPN information exchange	
Q2	Stakeholder Group recruitment complete with meetings held to review Terms of Reference and supplementary targets	Coaches successfully recruited and Host SLA's in place	Ongoing Stakeholder engagement	Ongoing alignment with wider SAVE trial focus and design			
Q3	Coaches in post 1 September – induction & community profiling commenced	Stakeholder 'bus tour' of trial areas and 1to1 meetings to identify key supplementary targets	Ongoing alignment & review of key messages with wider SAVE trial	SoLA Bristol project review			
Q4	De-synchronisation of SAVE trials	Coaches initial assessment of key DDS issues as per profiling work	Sharing the 'coaching' approach with coaches and Stakeholders	Initial baseline data analysis by UoS / tEC	Learning visit to CSE/WPD/Bath University re 'Less is More' and SoLA Bristol		
2016	**Phase 3 - First Trial Iteration**						
Q1	Local engagement commences	Trial design / baseline activities and associated recognition of Energy Literacy issues	Stakeholder Group input into co-design process	Mitigation planning as lack of data analysis support and attributability issues become apparent	Learning Visit to ENW re Power Saver Challenge		
Q2	Connecting Kings Worthy – People, Places and Power agreed as DDS framework	Shirley Warren Working Together identified as likely way forward	Change of SW Coach	Data streaming / creative platform design ongoing	Impact measurement model options reviewed		
Q3	CKW local branding and activities especially around shortcuts and walking to school	First community co-design sessions take place	SSWT branding &framework in place – focus on community café & clean ups	Develop Area Level model to support data analysis	Detailed Intervention Programme in place		
Q4	Feeder level monitoring in place	Formal trial interventions delivered to targeted households	Ongoing DDS and co-design work in both communities	Analysis of 2015 baseline data	Stakeholders meet residents in KW	Creative platform now tied to local branding	Change of KW coach
2017	**Phase 4 - Further Trial Iterations**						
Q1	2nd phase of formal trial interventions moving into 'challenge' year	Doorstep feedback undertaken	Stakeholders meet Shirley Warren residents	Full Energy Test programme finalised	Lightbulb Challenge launched as overarching 'energy' brand	SWWT formally constituted	KW Welcome Map distributed
Q2	Integrated DDS & Interventions Programme now in place	Formal 'Situation Statement' reviewing options & mitigating activity to compensate for data shortcomings	Ongoing local activities for example Money Saving Event in SW/ local fairs in KW	Focus Group sessions held to design next formal interventions			
Q3	Final intervention co-design and creative materials developed	Messaging Focus Groups held	Feeder selection for final planned interventions now made	Worthys Festival and fundraising activity in SW focus for ongoing DDS work	Data analysis template agreed		
Q4	Lightbulb Community & Big Switch Off promotion and event	Final set of Formal interventions delivered	Convergence Focus Groups held	'Making the Emotional Connections' video	Ongoing DDS activity in both communities with a focus on hand over and legacy preparations		
2018	**Conclusions & Wrap Up**						
Q1	Review of trial interventions to date	Legacy meetings with SWWT, CKW & Host organisations to review lessons learned and intentions to sustain actions	Meetings with SSEN Engineers and CRT to review initial findings	Final dissemination session with Stakeholders and residents from both communities			
Q2	Final data analysis approved for sharing publicly	Wider dissemination activities for example WRC Measuring the Impact Close Down event	Creation of project video(s) to aid dissemination	Formal submission of SDRC 8.8 end of project report to Ofgem			

1.5 Network Investment Tool

The Network Investment Tool is built from three models, which are presented below. Additional details on the Network Investment Tool are available across a series of SDRC's showing build (SDRC 2.1-2.3, 7.1-7.2 and 7.3/8.5), interaction (SDRC 8.5/8.6) and outputs (SDRC 8.2).

1.5.1 Customer Modelling

Built by the UoS, the Customer Model (CM) provides daily electricity demand profiles for a number of 'customer types' which are used by the Network Model (NM). Initially the CM outputs provided aggregate area-based load profiles using a spatial-microsimulation approach (SDRC 2.2, Section 5). Development of this approach was discontinued and outputs re-aligned to meet the emerging input requirements of the NM. Non-spatial demand profiles were developed using a customer typology defined using the three household characteristics that best predicted the variation in consumption during peak hours: household size (number of people), dwelling size (number of bedrooms) and primary heating fuel. The sub-categories within each of these variables were aligned to match those available in Census data at OA level. The final model implemented a typology of 22 different customer types defined using combinations of the three variables, balancing model fit with sample size (data availability) and the number of customer categories for practicality in running profiles (see SDRC 2.3, Section 3.2 for more details).

Development of the CM in line with the project objectives and to integrate within the NIT involved responding to the following during the work programme (for more detail refer to SDRC2.3, Sections 3.3 and 3.4):

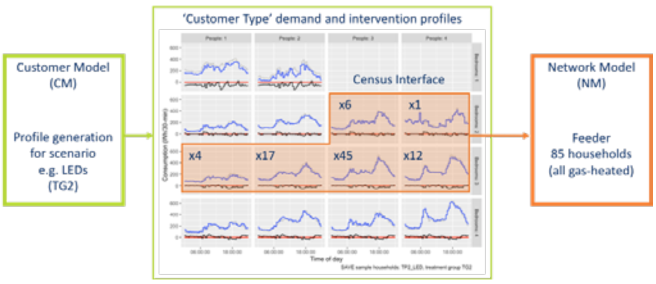
- NM (WinDebut) capacity to run only 50 profiles provided constraints to the scope of the customer typology;
- Small sample size for less common customer types with low representative populations (particularly non-gas-heated households);
- Asymmetries in observed consumption between control and intervention groups (and customer type subgroups) introduced high levels of uncertainty to the intervention impact estimates and limited the applicability of intervention impact profiles for some customer types.

These were mitigated in the final model by:

- Combining less common customer types where appropriate to maintain sample size and reduce the number of customer types;
- Developing synthetic baseline profiles for less common customer types;
- Applying a lower level of disaggregation to the intervention impact profiles to reduce small sample effects.

The CM outputs provided electricity demand profiles under both 'baseline' and 'intervention' conditions for each customer type (detailed in SDRC 2.3, Sections 3.3 and 3.4). By using the customer typology in conjunction with publicly available Census OA statistics, customer load profiles were mapped to specific network geographies. Using the OA level statistics for the three variables underpinning the customer typology, the Census Interface built by SSEN simulated the number of each customer type present on a chosen network (feeder) and the correct load profiles were then selected and placed within the NM (detailed in SDRC 8.5 & 8.6). The allocation of the appropriate number of profiles of each customer type to a network is visualised in Figure 6.

Figure 6: Allocating customer load profiles using Census Interface



This process allows the NM to estimate demand on a given substation before and after an intervention is applied. 'Baseline' profiles were created using 6 distinct days, one as representative for each season and two 'special days' (to model extreme circumstances most likely to cause network overload). 'Impact' profiles were created using the difference-in-differences approach to estimate treatment effects. The 'intervention' condition profiles were then created by applying the impact profiles to the baseline profiles from the appropriate season, largely winter (see SDRC 2.3, Section 3.4).

1.5.2 Network and Pricing Model

SAVE's Network and Pricing Model (PM) are built in Microsoft Excel providing users a single interface in which to analyse network loading. In October 2014, SSEN ran a competitive tender to identify a delivery partner for build of a NM.

EA Technology identified a cost-effective and high-quality solution build around their WinDebut interface. The 'Debut' engine allowed for load-flow studies to be carried out within the NM and could hold up to 50 customer type profiles at 30-minute granularity. This data was applicable with the projects 'Loop' monitors. EA Technology, SSEN and UoS initially met monthly to define interfaces between the CM and NM, notably settling on the requirement of customer profiles as detailed in 1.5.1 and a CI (see SDRC 8.5/6, Section 3.2.2). The project began development on a PM alongside the NM in May 2014, building a wireframe model which is detailed in SDRC 4.

As the NM and CM evolved throughout 2015 to 2017, SSEN looked to further develop the projects PM to provide best fit analytical outputs from the network models load-flows and in line with requirements highlighted by internal planning, connections and commercial teams. A competitive tender to build on SAVE's 'wireframe' PM concluded in May 2018 with EA Technology being awarded the work.

The PM uses network loading outputs (from the NM) based upon a range of (up to 4) load-growth scenarios. The PM uses pre-loaded costing information (network, SAVE and smart interventions) as well as intervention profiles from the CM (using the CI as in the NM) to understand the load-reduction expected on the substation in question and the most cost-effective sequence of interventions to manage each (pre-loaded) future load-growth scenario that has been forecasted (this discounts deferral using NPV). The PM does this using a range of strategies to provide insight into potential option value from deferring large capital investments. Least regrets analysis is applied to support planners in identifying which strategy may be optimal for them to adopt. This sequence of analysis is termed Multi-scenario and is explored in SDRC 8.5/8.6 Section 4.4.

The PM also offers:

- an incentive module which uses elasticity curves made from SAVE's dynamic pricing trials to understand how different customer types respond to different price signal levels.
- An HV/EHV interface to provide direct comparison of SAVE intervention capabilities at HV/EHV and the potential costs/benefits of implementing them over traditional reinforcement against pre-set load growth assumptions.

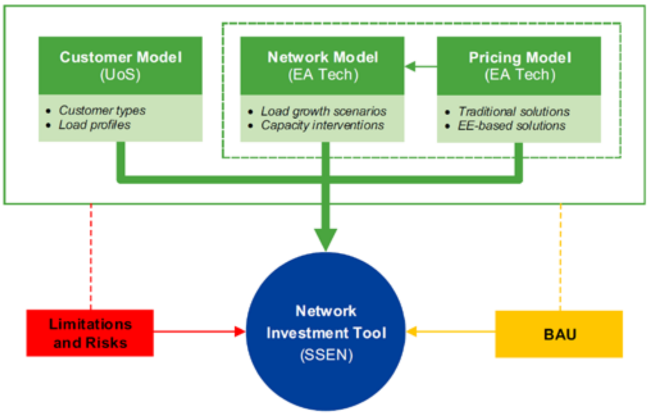
1.5.3 Final Tool

The NIT is the term used to describe the accumulation of SAVE's CM, NM and PM (Figure 7). In its fully integrated format, the NIT can provide capabilities to run single, future and multi-scenario analysis (Section 1.5.2). SDRC 8.2 reports on the outputs of the NIT by looking at a series of case studies and identifying the tools flexibility to be tailored to different DNO needs.

Key findings include:

- SAVE interventions can be part of an optimal network investment strategy, particularly where load growth is slow and significant forms of traditional reinforcement are required
- SAVE interventions may be more effective in areas that already have electric heating
- Future LCT uptake may result in shifts in peak demand requiring evolution of SAVE interventions to target other times of day
- The NIT provides an ability to easily track and evaluate the urgency and timeliness of network interventions.

Figure 7: Network Investment Tool



1.6 Business as Usual Delivery

In order to support BaU integration of SAVE trials the project identified three key areas for industry consideration of the projects outcomes, namely: regulatory, commercial and operational.

1.6.1 Regulatory Report

SSEN launched a competitive tender for a third party to evaluate possible regulatory barriers to BaU SAVE deployment. DNV GL and Energy Saving Trust (EST) worked together to deliver this piece of work. DNV GL and EST reviewed current regulations, policies and other energy efficiency schemes to inform the deployment of SAVE methods in a business as usual scenario and determine where barriers may exist. The main barrier to SAVE exists in the DNO licence conditions, as all other reviewed policies and regulations were generally favourable to energy efficiency schemes like SAVE. Potential barriers relate specifically to the installation of an electricity monitor behind the meter as ownership. These limitations can be easily mitigated by working with third parties or not using behind the meter monitoring equipment (as substation monitoring may be sufficient for some SAVE approaches). Additional details on barriers and mitigation strategies are available in the Regulatory Report.[18]

1.6.2 Commercial Report

SSEN have explored commercial parameters related to each of the projects 4 methods, this is detailed in Section 2.2. Specific focus was given to charging arrangements. This included work to identify potential routes to market for DNOs wishing to run a price signal based intervention (Section 3 of SDRC 4). This explored the realities of commercial deployment of SAVE's banded price incentives (Section 1.3.4) under both use of system charging and in flexibility markets (Section 9 of SDRC 8.4/8.7). The SAVE project has used its wealth of data to explore further how 'core' or 'essential' consumption could be used to future proof electricity charging under high LCT uptake scenarios. This report (Core Capacity) [25] was completed by CAG consulting and the UoR. The specification for this report was built in line with discussions with Ofgem and published as a sister report to Citizens Advices' 'Consumer Network Access, Core Capacity' [2]. Key outcomes identified include: there are clear income-related effects on peak-capacity ranging from 2kW in low-income households to 4kW in very high-income households (gas only); there is a wide variation in household peak for electrically heated homes, pointing to a need to consider heating load and/or heating technology; and, cooking and showering are key electricity-using actions associated with demand spikes. Vulnerable customers and regulatory considerations were also heavily focused upon within the report.

1.6.3 Operational Report

Throughout the project, ongoing liaison with network planning and connection departments identified the need for operational guidance to support the adoption of the projects NIT into BaU functions. This included a review of both industry practises and procedures (including: EREP 130, ACE 49, P2/6 and P2/7). The project looked for consultants who could both digest SSEN internal procedures and had knowledge of wider DNO procedures, TNEI were contracted to complete this work. An executive summary of this report can be found in Appendix 2 of SDRC 7.3 and 8.5. Key report outcomes include: a means of validating the NIT outputs, where SSEN policies and processes would require updating to accommodate SAVE interventions and the NIT and approaches to managing risk/ensuring capacity when procuring SAVE type interventions to manage the network.

1.6.4 Roadshows and training

The project has produced a training manual for the NIT to support usability and rollout of the tool across DNOs which can be found in Appendix 1.6.4. A training session, details on how to utilise these manuals and an overview of practical project integration was offered to each DNO in a series of roadshows discussed in Section 9.

18 DNV GL and Energy Savings Trust. SAVE Regulatory Report. 2019. https://save-project.co.uk/wp-content/uploads/2019/09/Regulatory-Report.pdf

2

THE OUTCOMES OF THE PROJECT

2.1 LO: to gain insight into the drivers of energy efficient behaviour for specific types of customers

LED lighting interventions

There was limited uptake of the offer for discounted LEDs in TP1. Approximately 19% of the group accessed the website, however only 0.4% of participants took up the discounted LED offer. While the offer was SAVE branded, it's possible many people dismissed the offer as an advertisement or 'junk mail' (for more details, see Section 2.2 of SDRC 8.3).

In contrast, TP2's offer of free DNO installed LED installations had an uptake rate of 76% and installed 6,135 LED bulbs. Surveys indicated that the main reason participants had not installed LED bulbs before the project was simply that they 'hadn't thought about it'. This shows the main barrier to LED adoption is simply awareness (Section 3.2 of SDRC 8.3). The TP2 campaign included phone calls and in-person visits, which can raise awareness more successfully than a postal mailer.

In TP2, vulnerable customers were more likely than the overall group to accept SAVE's offer of free LED bulbs (85% take up compared to 76%, respectively). The impact was also higher for vulnerable customers, with a greater wattage reduction than non-vulnerable (a 193 W maximum theoretical saving compared to 172 W, respectively). Section 4.3.5 in SDRC 8.3 has additional details on vulnerability.

Data informed and price signals

The SAVE project tested a number of reduction 'events' with various levels of success. Postal notifications were the most consistently successful method of engagement, followed by email notifications. Events that were run via text message were not successful. Offering a monetary incentive did not greatly influence reductions. Data from the TU Diaries showed that participants were significantly more likely to be out of the house during the event period than the control group. This suggests that for some participants, the easiest way to reduce their consumption is simply by staying out of the house.

Consumption was variable through TP1 and TP2 (relative to the control group). In general, periods of reduced consumption follow times of constant engagement, but this does not persist, showing evidence of messaging fatigue (Sections 7.1 and 7.2 of SDRC 8.4/8.7). This shows that engagement and education alone is not enough to provide persistent reductions in energy consumption. Some participants complained that the messaging was too frequent, but overall the feedback was mostly positive.

In TP3 (banded pricing), under the lower incentive, the per household reduction was higher in the opt-in group (TG3) than the opt-out group (TG4). During the higher incentive period, overall group reductions and per household reductions were higher in the opt-out group than the opt-in group (see Section 7.3 of SDRC 8.4/8.7 for additional details). The opt-in group seemed to be less motivated by money—their reductions were broadly consistent over the whole trial period. The reductions of the opt-out group, however, increased markedly after receiving the offer of higher incentive. This suggests that self-selecting (opt-in) households are relatively engaged with energy consumption already, and likely to have lower energy consumption on average than the control group.

There were no significant differences in results between vulnerable and non-vulnerable households.

Community Energy Coaching trials

SAVE SDRC 8.8 (Section 4.4.2 in particular) notes a more qualitative overview of drivers for energy efficiency behaviour, including:

- The key driver across communities was the idea of being part of a collective aspiration for change
- A requirement for simple and clear energy literacy to explain the 'why' and 'how' of energy efficiency
- Resistance to change around cooking habits could be addressed by leveraging the benefits of saved time through slow cookers
- Cooking and food were also seen as a compelling method for engagement, especially at events to start discussions, this could then build upon to discuss wider 'shift' messaging.
- A joined up and clear message is needed between key local stakeholders (i.e. utilities) to drive coherence in change
- By 'earning the right' to engage residents feel listened to and hence are more likely to listen to the messaging of the DNO
- Co-produced community brandings provided a 'trusted local messenger' to reach out to people through
- Get the community involved in (legacy) planning after earning their support and trust

SSEN has used insight from the UoS customer model (see SDRC 2.1-2.3) to create visual representations (by LSOA) of how different customers may respond to different interventions. This data can then be layered with other relevant information such as proximity of fuel poor households, see appendix 2.1.

2.2 LO: to identify the most cost-effective channels to engage with different types of customers

The deployment costs per kW of reduction for SAVE interventions are presented in Table 2 below.[19]

Table 2: Cost of SAVE interventions[20]

Intervention Method	Peak Reduction (W)	Cost per kW	Deployment Effect
Energy Efficiency	47	£2,400	Continuous
Data informed via email (per event)	11	£17	Event based
Data informed via post (per event)	23	£29	Event based
Price signals (banded pricing, opt-in group)	17	£1,600	Continuous
Price signals (banded pricing, opt-out group)	44	£560	Continuous
Community energy coaching	0-140	£280-£1,100	Event based

The cost of deploying LED bulbs was approximately £2,400 per peak kW per household. In contrast, the cost per event (excluding incentives) was £29 per peak kW per household for postal communication and £17 per kW per household for email communication. (Because no text message based events resulted in kW reductions, they are not included in these calculations.) The cost of deploying the banded pricing intervention was £560 per kW per household.

The CEC trials cannot be quantified in a £/kW manner as neatly as the other trials given the social nature and on-going engagement integral to the trials' methodology. Within Appendix 13 of SDRC 8.8 it is noted how the cost of CEC may change with BaU deployment and economies of scale. This suggests costs may vary from 100k down to 25k at large scale rollout of CEC across 1000 customers. With an average load-reduction of 89W per customer[21] or 89kW. Costs per kW therefore could be assumed to vary from £1,100-£280 per kW.

Table 2 above shows the timescales over which the peak hours reduction for each deployed intervention were observed. It should be noted that the reduction in load due to the LED lighting upgrades were significantly more persistent than other interventions, with reductions throughout most of the winter period. In contrast, the reductions observed during some event-based and CEC interventions were occurred over much shorter time periods. The reductions from banded pricing fall somewhere between. When comparing the deployment costs, it is therefore important to consider the characteristics of the load reductions observed. Determining which approach is most cost effective also needs to consider the nature of the network constraints, for example whether peaks are regularly occurring or not.

Alongside the kW/kWh reductions cited above SAVE initiatives may also bring about a range of wider social benefits. Some such social benefits are recognised by DNOs via RIIO, for instance the engagement of fuel poor and vulnerable households. In the instance of LEDs, vulnerable households were more likely to accept the offer of free light bulbs and the wattage of the bulbs removed from vulnerable households tended to be higher than those from non-vulnerable households. SAVE has worked across stakeholder engagement teams to support in quantifying the value of such activities (Section 3.4 of SDRC 8.8). Other such benefits are currently external, for instance savings to customers bill and carbon reductions. Such calculations are shown in business cases in Section 7 of SDRC 8.3 and are beginning to be acknowledged in SSEN's SCMZ project.

For all approaches, the intervention needs to cover enough homes in a given geographical area to make an impact. If too few households are offered the intervention, the impacts will not be seen at network level.

19 Costs are calculated on the point estimates of observed treatment effects and attention should be paid to the corresponding confidence intervals for each intervention detailed (see relevant SDRC reports). It is recommended this table is looked at alongside section 6, business case to understand the value of each intervention.

20 For brevity, this report quotes estimated outcomes (treatment effects) as point estimates. Confidence intervals that indicate the uncertainty around these estimates can be found in SDRC 8.3 (LED lighting) and SDRC 8.4 & 8.7 (Data informed and price signals). Deployment Effect refers to the timescales over which the observed peak-hours effects persist. Refer to SDRCs for details.

21 SDRC 8.8 notes an average load reduction through the targeted CEC intervention of 10.6% and UoS analysis found mean weekday peak consumption across winter months to be 0.843kW per household.

2.3 LO: to gauge the effectiveness of different measures in eliciting energy efficient behaviour with customers

Through the RCT experiment design, and the use of a number of statistical techniques implemented over a number of temporal scales, the analysis provided estimates of the treatment effects attributable to each intervention. The electricity demand observed in each trial group was compared to that observed within the control group and statistical analysis was used to evaluate the response to each treatment. Due to slight asymmetries between the observed consumption within treatment and control groups, a difference-in-differences approach was used to estimate the treatment effects.

LED lighting interventions

The impact of the intervention trialled during TP1 was not evaluated due to the low rate of uptake. The full results of the trial outcomes are provided in SDRC 8.3 (Section 5). The impact of the rollout of LED lightbulb upgrades during the second trial period was found to reduce consumption in the treatment group with reductions in electricity consumption following a seasonal pattern and maximum reductions corresponding to minimum natural daylight availability in midwinter. The estimated average change in consumption, using two measurement periods (daily average and average over peak hours), was as follows:

1. Daily average: the maximum observed change occurred during the week commencing 1st January 2018, with an average 7.0% reduction in demand.

2. Peak hours only (4 to 8 pm): the maximum observed change occurred during the weeks commencing 25th December 2017 to 15th January 2018, with a mean estimated 7.6% reduction in demand.

Data informed and price signals

The SAVE trials tested a number of data-informed and price incentive interventions with the recruited representative sample. The engagement approaches are detailed in summary in Section 1.3 above (and in full within SDRC 8.4 & 8.7). The majority of engagement approaches tested in the trials resulted in reductions in electricity consumption during peak hours. Results from TP1 and TP2 event days are shown in Table 3 below.

For the treatment group that did not receive a financial incentive (TG4), the postal engagement proved the most effective (TP2, Event 1), with a financial incentive providing a marginally larger response. For the price-incentive treatment group (TG3) a larger reduction in consumption occurred during the shortest event (TP2 Event 4). This provides evidence showing that providing a financial incentive in conjunction with short-term events (i.e. only part of the peak hours) may be most effective. The longitudinal analysis showed that the group offered price incentives increased consumption outside of the event periods (see Section 7.2, SDRC 8.4/8.7), whereas this was not true for the group that received no financial incentives. Such potential impacts should be considered when implementing financial rewards for short-term demand reduction events.

Dynamic pricing

In the banded pricing trial outlined in Section 1.3.4 above (and SDRC 8.4 & 8.7), the opt-in group (TG3) showed consistently lower peak electricity consumption than the control group. This was not changed to any great extent by the mid-trial price increase, suggesting a fairly inelastic PeD.[23] The opt-out group (TG4) responded better to the price increase, with lower consumption during the period with the higher price, suggesting they were more motivated by higher financial incentives although the effect was short-lived. The maximum treatment effects were observed during the high incentive period, and averaged over the peak hours (4 to 8pm), were as follows:

- Opt-in recruitment (TG3): a 2.6 percent reduction;
- Opt-out recruitment (TG4): a 7.1 percent reduction.

Table 3: Summary of TP1 and 2 results[22]

Event	Delivery Mechanism	Reduction target	Duration	Incentive	Data +£ signal	Data only
TP1 Event 1	Post and Email	10%	1 day, 4 hours	£10 gift card	-3.4%	-3.6%
TP2 Event 1	Post	10%	5 days, 4 hours a day	Raffle for £100 gift card	-5.5%	-3.8%
TP2 Event 2	Email	10%	5 days, 4 hours a day	Raffle for £100 gift card	-0.8%	-1.3%
TP3 Event 3	Email	20%	2 days, 4 hours a day	Raffle for £1,000 gift card	+3.0%	+2.4%
TP4 Event 4	Email	10%	1 day, 2 hours	£10 gift card to all	-7.0%	-3.0%

22 Confidence intervals that indicate the uncertainty around these estimates can be found in SDRC 8.4 & 8.7.
23 Price Elasticity of Demand- The level to which people alter their demand in response to a change in price.

The analysis also showed that households opting-in to the trial on average had lower consumption than those not opting in, indicating that these households might already be more engaged and aware of their energy consumption. Alternatively, this could indicate that less wealthy households (with lower consumption) saw the possibility to reduce their consumption (and benefit financially), such households may have had less scope to respond due to their already low consumption.

Analysis was also conducted using data collected from TU diaries to examine whether changes to specific activities and behaviours were observed in response to the interventions. The analysis revealed that households responded to the prompt to reduce energy use during TP1, event 1, by being away from home.

2.4 LO: to determine the merits of DNOs interacting with customers on energy efficiency measures as opposed to suppliers or other parties

SAVE built on learning from other LCNF projects in its recruitment exercises. NTVV specifically had identified how engaging through a trusted third party such as the council or university significantly boosted engagement rates. Recruitment materials included a signature from UoS the project was introduced as working with UoS. Qualitative evidence indicated that this resonated with participants many of whom referred to the project as being partnered by UoS.

The CEC trials on SAVE identified challenges of the DNO (and other large commercial entities) working directly with customers including the need to 'earn the right to talk' with communities. The CEC trials cite that by building a relationship with communities by listening to and addressing their needs before discussing the agenda of peak reduction broke down communication barriers and created an open and engaged community group.

Through working together as part of a wider stakeholder group the DNO was also able to ensure a clear and coherent message with wider utilities, councils and HA's. This avoided conflicting or replication of messaging to local communities. After SAVE's closedown event when participants were asked how DNOs should be engaging communities; 25% noted as a lead, 71% as a partner and 4% noted DNOs shouldn't be engaging communities. Through the CEC trials SSEN has since worked with SW and SGN to deliver joint utility school engagement programmes.

Interaction on the CEC trials also identified the value of a 'trusted messenger' as crucial. This was most effectively achieved on the project through local community branding, created with the support of the community group. .

When engagement material was sent out through community branding response rates to mail drops reached over 50% as opposed 6-20% for DNO branded engagement materials. SDRC 8.8 provides a wealth of wider insights into DNO led engagement in communities.

Legacy planning was carried out in each community and is detailed in Section 4.3.3 of SDRC 8.8. Communities were re-visited for focus group activities (as per SDRC 3.2) in November 2018, one year after trials closed- the findings of which are recorded in Appendix 2.4a.

It is noted in SDRC 8.3 (Section 7) how the DNO could build on these benefits of joint stakeholder working in the rollout of energy efficiency. By stacking water efficiency and gas safety with energy efficiency, SSEN has identified areas of the network in which energy efficiency can cost-effectively compete with traditional reinforcement and is working with the other utilities to set up an engagement programme. SSEN has also fed these findings into BEIS through regular meetings and CfE.

SAVE carried out stratified random sampling to engage a variety of 'big six', large (over 250,000 customers) and small (under 250,000 customers) suppliers. This was done across 5 rounds of engagement where each round included 1 'big six', 1 large and 4 small suppliers (later increased to 8 small given limited engagement). This resulted in 6 telephone interviews (2 'big six', 2 'large' and 2 'small').

Given difficulties engaging a wide variety of suppliers SSEN worked with NEA to utilise their market relationships and understanding to hold a supplier workshop looking at the topics of: energy efficiency/ECO, dynamic pricing, regulation and 'essential consumption'. The workshop was opened by BEIS and attended by 15 industry groups, over half of which were electricity suppliers. A full summary of this workshop and its findings can be found in Appendix 2.4b.

3

PERFORMANCE COMPARED TO THE ORIGINAL PROJECT AIMS, OBJECTIVES AND SUCCESS CRITERIA

3.1 Create hypotheses of anticipated effect of energy efficiency measures (via commercial, technical and engagement methods)

The sample design hypothesised reductions in consumption around 7.5% (original project bid, page 7), based on literature from previous trials. The sample sizes were determined with this assumption so that a reduction of that magnitude was likely to be statistically significant.[24] Both the LED trial (9%) and the event days (with price signals) (7%) resulted in peak reductions at this level. However, household consumption was more variable than hypothesized, which means the resulting confidence intervals were also larger than anticipated so some of these results were not statistically significant at this threshold. The maximum reduction seen in the data informed group (without price signals) was approximately 4%.

The project based its incentive levels on projections of what SSEN may be prepared to pay (per customer) for network reinforcement. This was used to set a baseline payment level which was adjusted upwards to test behavioural techniques and to understand customers PeD. At the levels tested, payment did not have a significant impact on household's consumption. The project also tested how impact from a small guaranteed payment compares to the impact of a large raffle. Literature suggested[25] that higher incentives are more likely to incite change than lower incentives (when payment is guaranteed), however higher payments do not always correspond to a proportionally higher response by customers. The project looked to expand on this to determine how a small guaranteed payment compares to the possibility of a larger payment (through a raffle prize). This also tested if a raffle might be better value for money. In general, the small guaranteed payment produced more consistent reductions than a raffle. The event with the largest raffle prize (£1000 grocery store gift card) actually resulted in an increase in consumption from the treatment group.

A surprising hypothesis the CEC trials were able to disprove was that of the ability to shift cooking related activities. Prior to project initiation, focus groups and interviews concluded from both communities and other projects collectively, that cooking activity was not an activity in which energy could be reduced at peak. By shifting individuals thinking away from energy saving and to the time saving of meal preparation and slow cooking the CEC trials were able to enact behaviour change around cooking related activities to shift energy usage away from peak times.

For additional information on project hypothesises and results, see Section 8 of SDRC 8.4/8.7, Section 6 of SDRC 8.3 and Section 3 of SDRC 8.8.

3.2 Monitor effect of energy efficiency measures on consumption across range of customers

Through the collection and analysis of the 15-minute household electricity consumption and survey data, the project was able to effectively evaluate the effect of DDSR measures tested during the trial periods. By directly measuring electricity consumption (in contrast to self-reported behaviour) the evaluation was able to detect customers changing their behaviour unconsciously.

Through the stratified random sample recruitment and subsequent RCT design, the project was able to remove selection effects and adequately control for non-response bias. Furthermore, by conducting analysis of the consumption data using a number of different timeframes the analysis was able to distinguish between short-term (novelty) effects and longer-term change. While the sample size for the trials was designed to be able to robustly detect the hypothesised effect for each of the measures tested, the observed effects on occasion were lower than those expected, and a number of learning points should be considered for future trials:

- Attrition is likely to be close to 10% on long-term trials and will require pro-active mitigation efforts.
- The communication channels equipment relies upon should be carefully considered to avoid data transmission issues

The evaluation of trial impacts also included analysis of the relationship of observed treatment effects to a selection of household characteristics. This was conducted to understand whether specific types of households responded more to interventions than others. In order to determine the extent to which the variable response to interventions was captured by the Customer Model, the characteristics examined included those used to define the customer typology (household size, dwelling size and primary heating fuel). A number of differences in average treatment effect were observed between different groups, for example households heated with fuels other than gas tended to exhibit higher treatment effects. While this analysis highlighted some differences between specific groups of customers, thus meeting the learning objective, the additional uncertainty introduced by comparing smaller groups of households means that the results have lower confidence.

24 at normative thresholds ($p < 0.05$).

25 For a full summary of literature reviewed for the SAVE project, see SDRC 1: Lessons Learnt on Energy Efficiency & Behavioural Change. https://save-project.co.uk/wp-content/uploads/2019/09/SDRC-1_Review-learning-from-other-projects.pdf

3.3 Analyse effect and attempt to improve in second iteration

LED lighting interventions

TP1's reactive approach to LED engagement had a low uptake rate and suggested that participants need more prompting to install LEDs. For this reason, TP2 elected to take a more pro-active approach, contacting participants by phone and in-person to offer them free LED installation. As hypothesised, the uptake for the second offer was significantly higher than the first (76% uptake).

At the conclusion of TP2, the project team concluded that there was limited value in attempting to installed LED bulbs in the remainder of the group. For this reason, TG2 was converted to a BaU messaging group in TP3 (see SDRC 8.3 and SDRC 8.4/8.7 for additional details), building on learning from previous data informed trials.

Data informed and price signals

Initial feedback (both drop-out stats and through focus groups, see SDRC 3.2) from TP1 indicated that a handful of participants were overburdened with the messaging, which was delivered by both post and email. Initial thinking concluded that most people have a preferred method of communication and may ignore others. For this reason, all communicators were sent via post and email. However, in response to the feedback from TP1, TP2 sent message via post or email, but never the same message through both. The first half of TP2 focussed on postal communications and the second half was online only.

TP3 was not scoped at the time of bid submission and was introduced following CR1 (section 4.1). The SAVE project drew on learnings from TP1 and TP2 as well as an industry consultation to develop the banded pricing trial. It tested how results differ between an opt-in and opt-out group and also how responses vary based on incentive levels.

CEC trials

The CEC trial periods built on each other more sequentially than the other trials, in which each TP was kept mutually exclusive to test separate interactions of engagement. The CEC trial journey is summarised in Figure 8.

Figure 8: CEC trial evolution

3.4 Evaluate cost efficiency of each measure

The cost per kW reduction per household is outlined in Section 2.2 above. The events are the least expensive measure, specifically those delivered by email. Events are generally more effective if launched in conjunction with a wider engagement campaign (as seen in SDRC 8.4/8.7).

LEDs were the most expensive, while banded pricing costs fall somewhere in between. The events however, are only one-off reductions and therefore may not represent good value for money on a network with regular peaks. LEDs, in contrast, offer a more consistent reduction and are likely to be in place for multiple winters. Banded pricing also provides reduction over an entire season, however it is less predictable than LEDs and its impact does not always coincide with network peaks. For this reason, which approach is most cost-effective will depend on the needs of the network in question.[26]

CEC was estimated as slightly more expensive than banded signals but less than LED's, however quantitative results are not statistically significant and as with event-based trials longevity can be limited.

SAVE has revised business cases from the initial submission which suggested impacts of interventions at LV and HV with more rigorous analysis using real as opposed theoretical impacts and recognising the accountability for wider social benefits and smarter means of working such as joint utility and SCMZs. This is discussed in Section 6.

26 i.e. as the event based trials are potentially more Opex based and the energy efficiency trials more Capex based; a regularly peaking network may benefit from a Capex heavy LED intervention which doesn't then get more expensive with more events. A network which peaks and hence requires DR only a few times a year however may benefit more from the Capex light event based interventions. SSEN is building this learning into its SCMZ flexibility services.

3.5 Produce customer model revealing customer receptiveness to measures

As detailed in Section 1.5.1, the University of Southampton delivered a CM providing an evaluation of the impact of the SAVE interventions on household consumption during peak hours (Section 2.3). The **analysis examined the variation of impact across a number of household characteristics, revealing customer receptiveness to each measure** (Section 3.2).

The CM has demonstrated a method with which the observed consumption and estimated treatment effects for a number of *customer types* (i.e. **expected receptiveness to measures**) can be represented as average 'baseline' and 'impact' profiles, selected in the correct proportions according to small areas (using the CI), and passed to the NM (see Section 1.5.1 and Figure 6). This allowed the subsequent **simulations to capture a limited representation of the variation in household characteristics (and the associated variation in baseline demand and intervention impacts) in the true customer population**. This is a major step forward from current practice which uses a single 'residential' customer profile to represent all customers under baseline and impact conditions.

In the final model (NIT), the CI module provides the integration of the CM and NM and provides the **interactive, analytical geospatial (GIS) functionality to build and interrogate scenarios and undertake simulations** of network assets using the load profiles generated by the CM.

3.6 Produce network model revealing modelled network impact from measures

The NM was developed to analyse LV and HV distribution networks under various load and LCTs update scenarios. The model uses distribution NM and CM output data to simulate impact of domestic customers on the local distribution network and also the benefits their can have when SAVE intervention is deployed.

The NM was designed to allow users the capabilities to build a customisable representation of their LV networks. Templates can be saved for use as 'representative networks' or for re-runs on specific case-study sites. The model will then use a CI to map 'customer types' from the CM onto a bespoke network. This builds a representative 24-hour profile for one of 6 'special days'. Forecasts can also be run using a variety of either pre-loaded (FES) or bespoke annual uptake rates of PV, EV's and HP's. This allows for runs of what is called single scenario analysis (looking at a snapshot view of the load-profile on a given substation) and future scenario (understanding how that profile will change over time) and provides analysis of: capacity (over time a 24 hour period and 'branch-by-branch), voltage and how these variables change over time (future-scenario only). For a full overview see SDRC 8.5/8.6, Sections 4.2 and 4.3.

The NM allows an investigation into whether the network is delivering acceptable voltage to customers and if the loading upon circuits remains within acceptable limits. This gives network planners the insights of level and duration of maximum demand, available loading and voltage headroom as well as level and location of potential overload and voltage issues. When the network issue is detected, the model can be used to investigate if any of SAVE interventions can be an effective solution to relieve network constraints as an alternative to network reinforcement (more details can be found in SDRC 8.5_8.6).

3.7 Produce a Network Investment Tool for DNOs

Integration of CM, NM and PM delivers a functioning NIT. The NIT and its underlying suite of three models (as shown in 1.5.3) have been designed to allow analysis of how changes in customers energy consumption, such as behavioural, uptake of LCTs or time of use tariffs affects distribution network. The tool also enables the network planners to investigate if using 'smart' interventions, customer engagement and energy efficiency measures can be more beneficial to network management than traditional solutions (including reinforcement).

The NIT has been designed as a forward-looking tool, with a DSO in mind to provides the means to assess and then select a cost-efficient methodology for managing electricity distribution network constraints. The NIT considers the effectiveness of different types and degrees of energy efficiency and engagement interventions, as well as more traditional techniques for network reinforcements and 'smart' solutions, as potential approaches for a better informed, more cost efficient and sustainable management of networks as DNOs take on DSO functions.

The NIT's load-flow engine provides a planning department with the ability to run up to four network scenarios simultaneously to provide a spread of potential future scenarios. By pairing this information with a commercial interface, the tool offers three strategies per scenario on how to manage the network over time. These strategies compare the cost of smart, SAVE and traditional reinforcement options as well as the capacity they may offer and the NPV of intervention deferral. This will allow more informed planning forecasting, more cost-effective network management and identification of where and when smart or SAVE interventions may be applicable over traditional measures of network management

Within a DSO environment the NIT can be used to assess whether it should be looking to the market for flexibility solutions as a potentially cost-effective alternative to traditional reinforcement. Relevant sites could then be added to a portfolio for competitive tender (such as SCMZs). Once tenders are delivered, the NIT's outputs can help assess whether said solution is likely to provide the security of supply the network requires.

3.8 Produce recommendations for regulatory and incentives model that DNOs may adopt via RIIO

SAVE's pricing (incentives) model provides users with the functionality to compare and identify which mechanisms will be most cost-effective in a given area based upon both customer types and engineering specificities. The PM does this by performing load-flows over a combination of load-growth scenarios and strategies and uses regret analysis to define a recommended strategy (see SDRC 7.3/8.5 and SDRC 8.5/8.6). This, when combined with other models to form the NIT, provides DNOs a simple mechanism with which to assess the cost-effectiveness of flexibility against traditional means to reinforcement on the LV network as per the ENA's 2018 letter to the secretary of state, Greg Clark [3].

Within the PM the software offers an incentive module. This module uses elasticity curves to determine "appropriate price signals to [pass] onto consumers" (SAVE bid document) to manage a given network constraint.

The PM and incentives module can be used by DNOs to inform the level and effectiveness of SAVE interventions. The cost and implementation of these interventions will be affected by three key areas investigated by the SAVE project:

1. Government Policy around energy efficiency. The carbon plan notes targets for near zero emission buildings by 2050, in order to achieve policy direction around energy efficiency could change significantly (including ECO and the Green Deal) in coming years. SAVE has fed in to numerous BEIS discussions and is referenced as an example in July 2019's Facilitating energy efficiency in the electricity system, CfE [1]. Such changes could greatly impact the cost-effectiveness of SAVE type initiatives, hence flexibility on costing has been built into the NIT and is demonstrated in case-studies in SDRC 8.2.

2. Changes to industry charging arrangements (including DUoS) under DCUSA. In SDRC 4 (June 2017) SAVE explored potential routes to market for price signals through existing mechanisms. In June 2019 SAVE published a sister report with Citizens Advice looking at the increasing thinking around 'core consumption' [25].

3. To roll-out initiatives in BaU, SAVE saw it important to understand potential barriers to market and hence published its regulatory report in April 2019 [4] to inform how to rollout the recommendations of the NIT (and into SCMZs).

4

REQUIRED MODIFICATIONS TO THE PLANNED APPROACH DURING THE COURSE OF THE PROJECT

SSEN submitted two formal CR's, both of which were fully supported by the Project Partners and accepted by Ofgem.

4.1 Change Request 1 – Trial Design and Equipment

CR1 was submitted in February 2015 with two distinct parts. The first aspect of the change was to modify the active trial periods laid out within SAVE's bid submission. It identified that a more effective trial structure offering could be facilitated with no impact to project budget. Namely the integration of an additional trial period (from two trial periods to three) increasing the potential for learning and refined engagement approaches on the project.

The Second aspect of the change was to the household monitoring equipment from optic sensors as identified within the Full Submission to clip-ammeter monitors. Coinciding with the review of Project Learning completed within SDRC 1. Wireless Maingate (Project Partner at the time) had identified an alternative to the 'NorthQ' optical sensors proposed for the project and in the Full Submission. The Aeon labs clip-ammeter gave comparable accuracy but a more efficient fitting process and the added advantage of not requiring to be secured to the individual meter, resulting in reduced installation time and reduced risk of connectivity or communication loss during or following meter recertification. The equipment changes improved installation time and efficiency during the initial recruitment period.

As detailed in CR1, neither change was resultant from adverse issue or scenario, both stemmed from improvements identified during project progression.

4.2 Change Request 2 – Project Extension and Equipment

In June 2016 SSEN submitted the second formal change request following a period of significant and sustained communication with Ofgem resulting from a critical failure of the projects household monitoring equipment and its subsequent impacts.

In July 2015 SSEN advised Ofgem of a suspected failure within the household monitoring solution. Detailed investigation concluded that the batteries in this element were failing within 4 months of installation, effectively removing the project's ability to accurately assess the impact of interventions for methods 1, 2 and 3, however it did not impact the Project trials of method 4 (CEC). The failure of the devices resulted in the requirement to replace the monitoring solution across the whole recruited sample of 4,007 active participants, with the additional impact of those corrective actions being a 12-month delay to all deliverables associated with methods 1-3 of the Project, to allow re-installation of new monitoring equipment. In March 2016 following lengthy discussions between the Project and Maingate, Maingate advised SSEN that they had filed for insolvency and would no longer be part of the Project.[27]

The first key aspect of the change proposal was to delay live trials of interventions 1-3 and all associated deliverables by a period of 12 months, allowing installation of new equipment across the project sample of 4,007 participants. The second key aspect of the change proposal was to remove Maingate Enterprise Solutions as a partner of the Project and appoint Navetas Ltd as the supplier of equipment and all associated services to trials 1-3 of the Project. The added granularity of the Navetas 'Loops' substantially increased the quality of the data available to the Project beyond that originally planned. To mitigate against potential cost increases, the third key element of this change request was the re-structure of the SAVE project budget. No additional budget was requested despite the significant impacts suffered by the project and detailed within the change request.

The proposed change delayed all related SDRC's and extended the project's completion by one year to June 2019. This delay ensured the overall aims of Project SAVE, both direct and indirect learning and deliverables could be maintained in line with the Full Submission and Project Direction.

CR2 provides an amended full submission and governance document for the SAVE project and contains more details around the mitigating actions taken and the partner liability dispute with Maingate.

27 Maingate included reference within their insolvency notification that there were an unspecified number of reasons for their decision to liquidate and that the SAVE project was not the only contributing factor

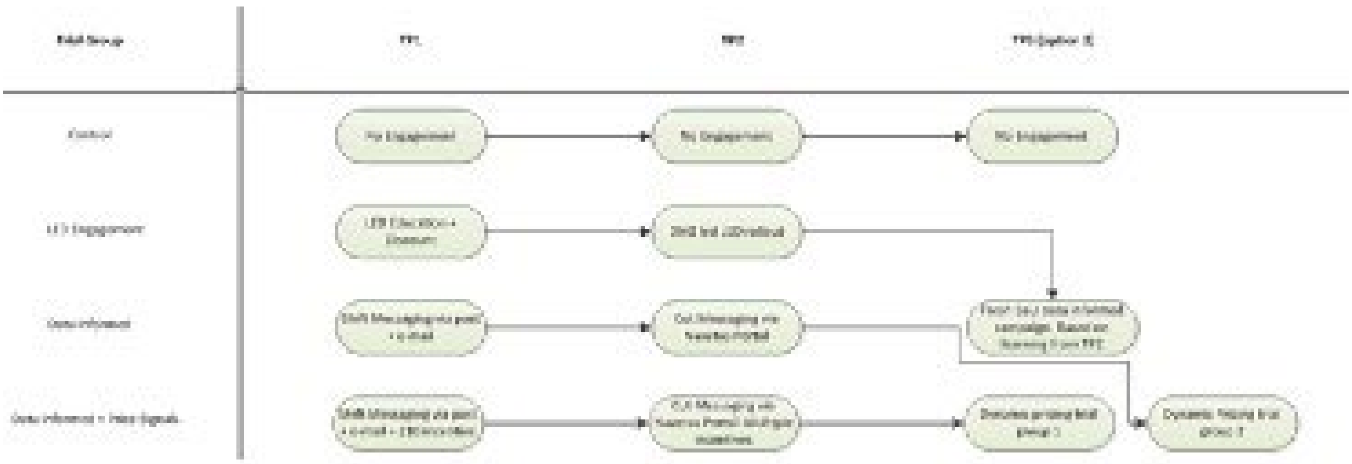
The changes have been delivered, within the 12-month extension as planned, without the requirement for additional budget requests; the project opting instead for a restructuring of the budget with applied efficiencies implemented and planned throughout the remaining project lifespan. This has required large amount of commitment from all those involved in the project, including partners and key suppliers. SSEN is immensely proud of these achievements when considering the extent of the impacts the CR was implemented to address.

4.3 Re-alignment of project trials

In January 2018, UoS were able to begin presenting the success of TP2 LED engagement (SDRC 8.3, Section 2) with 76% uptake of LED's across the trial's population. Rather than run a third LED trial period as planned the project concluded that any additional learning from engaging the remaining 24% of households would be neither replicable of cost-effective BaU practice, nor determine best learning outcomes for the project. As a result, the project looked to industry literature and held discussions with Ofgem to determine a new form of price signal intervention (termed peak banded pricing) which could make best use of project resource (other forms of energy efficiency were also assessed as per June 2018's project manager report).

SAVE held an industry consultation, the results of which are shown in Appendix 4.3. This illustrated a preference for SAVE to trial a 'peak banded tariff' testing both opt-in and opt-out methodologies to build upon previous more 'opt-out' based LCNF trial results. The re-aligned trials are presented in Figure 9.

Figure 9: TP3 realignment



5

SIGNIFICANT VARIANCE IN EXPECTED COSTS AND BENEFITS

5 Significant variance in expected costs and benefits

Table 4 (right) provides a summary of the spend variance at project closure against the revised project budget categories summating to £9,643,680 as defined in the revised project direction agreed in Appendix 6 of CR2. The below shows SAVE was able to achieve a 14.27% underspend (taking account of actual interest compared to presumed interest) and as result will be transferring £1,094k back to customers. A combination of realised efficiencies, good project risk management and close stakeholder relationships to leverage in-kind contribution were central to achieving this.

At project inception interest rate forecasts suggested £335k of the projects budget would be made up through interest. In reality interest rates have been lower than forecast over this period with the project making £53k in interest. Accounting the projects Ofgem defined contribution of: £8,293,396.47 with a DNO contribution of: £1,015,536.77 and the actual achieved interest rate the project budget sits at: £9,362k. SSEN therefore close the project with a net positive budget of £1,095k.

Table 4: Project Spend vs Budget

Category	Budget at CR2 (k)	Spend (k)	Difference (%)
Labour	£1,848	£1,178	63.7
Equipment	£1,015	£1,031	101.6
Contractors	£5,085	£4,901	94.6
IT	£587	£599	102.1
Travel and Expenses	£26	£57	215.9
Payments to users	£472	£297	62.8
Decommission	£207	£100	48.3
Other	£403	£104	25.9
	£9,643	**£8,271,730.61**	**85.7**

Table 5: Variance in spend over 10%

Category	
Labour	The SAVE Project team was recruited to provide the project with a diverse range of skills. Through recruiting a commercially minded project manger the project was able to save commercial budget and competitively procure work that could not be fielded by the project manager. Lean project management methodolog ies were utilised alongside processes developed across SSEN's NIC portfolio to minimise the implementation and development of new processes allow the project manager to focus on more strategic and commercially orientated responsibilities. By maintaining a close and well communicating project team (both within SSEN and across partners), through a variety of regular, work package orientated meetings, alongside monthly PPRB's the project has minimised time lost on disputes and ensured partners are able to deliver added value from their contracts to address project aims, objectives and success criteria.
Travel and Expenses	To accommodate the decreased labour spend the projects team were geographically spread more thinly than they might have been otherwise hence travel expenses to attend meetings and disseminate learning were increased. Likewise, through collaborating and building upon existing dissemination opportunities (a reason for dissemination efficiencies) the project team often found themselves travelling to events as opposed hosting them locally.

Table 5: Variance in spend over 10% (cont.)

Category	
Payments to users	The SAVE project forecasted a total of 4800 recruitment surveys (incentivised at £30), 4800 update surveys (£5) and 4800 time use surveys (£5)[28]. Both update and TU surveys proved harder to obtain than anticipated. Despite field contractors, BMG, making up to 20 attempts at contact in some instances, final surveys achieved reached: 4631 recruitment surveys, 4218 update surveys and 3559 TU surveys. The other allocation of payments to users on SAVE was for the price signal/dynamic pricing trials. Savings were made across each of the trial periods against budget allocations. In TP1, the event day had a pass rate of 55% for the price signal group, meaning 512 out of a potential 931 participants were paid a £10 incentive for achieving the projects 10% reduction target. In TP2 the project built on learning from TP1 by implementing a variety of different behavioural techniques including raffles[29]. The project decided that raffles should strike a balance between being a motivating amount of money whilst also seeming realistic and replicable. Even the projects largest, £1000 raffle saved significant amounts compared with event days; (assuming a £10 payment per customer, any pass rates above 10% would be more expensive). Re-designing TP3 to test 'dynamic pricing' as opposed event days again saved on incentives given a requirement for more long-term engagement than a one-off event. By running an opt-in, as well as opt-out trial the project reduced potential participants payments.
Decommission	The SAVE project began decommission planning and discussions 1 year before project closedown and 6 months before field work could commence.[30] This ensured the project team could assess a range of options with regards how best to manage project equipment and have the appropriate commercial discussions. As noted in Section 1.1.3, by working with project partners UoS, Navetas and BMG the project created a plan which allowed customers the option to continue to use the Loop free of charge with Navetas (and if they so chose, offer their details to UoS for future research) which also kept engagement costs low for the project. Alternately if kit removal was chosen costs were minimised by suggesting self-removal, phone support and then finally field staff removal.
Other	The main savings made in 'other' activities were in dissemination budget. The project was able to save a large amount of cost by utilising strong stakeholder ties. This facilitated in-kind venue hire and collaboration events which reduced costs (particularly on the CEC trials). Likewise, the project benefited from a central (programme level) knowledge and dissemination team who were able to keep a track of wider industry events the project could participate in. This reduced the cost of running bespoke events, at a slight increase in travel and expenses. Supporting this was a regularly updated stakeholder map, ensuring those who were high interest and high influence (i.e. BEIS, Ofgem, DNOs) were engaged frequently and often through one to one means (again low dissemination cost at the expense of higher travel/expenses costs). When it came to closedown activities the projects thorough planning allowed time for competitive procurement activities to minimise costs and was able to leverage contacts through the UoS to secure and identify politically focused venues at low cost. Given the support of a dedicated knowledge and dissemination team the project also minimised cost through keeping event organisation and logistic requirements internally, only forgoing the cost of consultants where specialist knowledge was required to support. A full summary of the projects' dissemination activities are discussed in Section 10.

28 This equates to one recruitment survey per customer, 1,600 update surveys per year over three years, and 1,600 time-use surveys per trial period (3).
29 This tested the 'possibility effect' termed by Kahneman, 2011 which suggest people overestimate small probabilities.
30 Decommission couldn't start until late January 2019 once trials had finished and 'loop' data had a chance to 'catch-up'.

6

UPDATED BUSINESS CASE AND LESSONS LEARNT ON THE METHOD

6 Updated Business Case and Lessons Learnt on the Method

The business case has compressed the project's 8 core objectives into two subsets, namely: trial outputs and the NIT. Section 6.1 below provides an overview of potential quantitative benefits from SAVE's trials both internal to DNOs (i.e. deferred reinforcement and reduced losses) and external (i.e. customer bill savings and carbon emissions) supported by values defined within the Treasury's 'Green Book' [32]. This is shown applied both at scale (across SSEN and the UK) and through differing rollout mechanisms. Section 6.2 focuses on the NIT, exploring each model that makes up its functionality and outlining where this can supplement and replace existing processes as well as the new functionality the tool can offer.

A full business case for the project can be found in Appendix 6. This provides a detailed comparison of realised project benefits to those outlined in SAVE's full submission as well as more on the trials' qualitative benefits and different rollout strategies.

6.1 Trial Outputs – Business Case

The assessment provides intervention specific evaluations of attributable costs and benefits to demonstrate the potential future application of the interventions and their findings. The analysis has found the LED and Price Signal interventions would be effective as long-term, BAU solutions.

The interventions implemented within the SAVE project aimed to examine a range of issues. In response to the differences of the interventions, the specific evaluation approach varies, see Appendix 6 for more details.

For the event specific interventions of Data Informed Engagement and Community Energy Coaching, the assessment predominately examines qualitative impacts and the key learnings from conducting the trials. The analysis reveals that both interventions produced significant kW reductions but minimal kWh reductions due to the short time in which they were active. The interventions provided numerous benefits including invaluable insights that can help shape future customer engagement strategies. The trials also gained significant knowledge of the understanding of energy awareness amongst customers and helped to address some of the existing gaps. The Community Coaching trial demonstrated the possibility of engaging with communities directly. The trial successfully installed a positive environmental legacy and greatly improved community cohesion and wellbeing, in addition to providing positive reputational benefits to the DNO.

The LED and Price Signal interventions provide continuous year-round impacts. The business case assessment evaluates their application up to 2050. The evaluation involves scaling up the interventions for SSEN's southern patch (2.9m households) and for the 27.2m households in the UK. The cost-benefit analysis illustrates that both interventions are cost-efficient and provide significant positive NPV when applied to business-as-usual. NPV calculations take into consideration the costs and benefits of the interventions, on society and on the network. The NPV for the LED intervention, when accounting for social benefits, was calculated at over £150m for SSEN southern patch scale, and nearly £1.5b for the whole of the UK. It is estimated network benefits may make-up around 1/4 of the LED interventions total benefit. Meanwhile calculations for the Price Signal intervention, assuming a zero-cost rollout through appropriate adjustments to use of system charging, show an NPV of over £420m for SSEN southern patch, and nearly £4b for UK wide roll out. Here it is estimated network benefits may make up almost 1/5 of total benefits. Waterfall charts for LEDs (Figure 10) and Price Signals (Figure 11) show summaries of the costs and benefits if these programmes were rolled out to the entire UK.

Figure 10: CBA Breakdown – LED intervention – UK wide implementation (£m 2019)

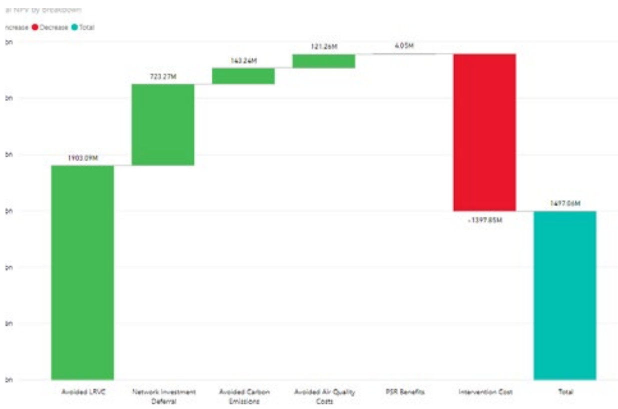
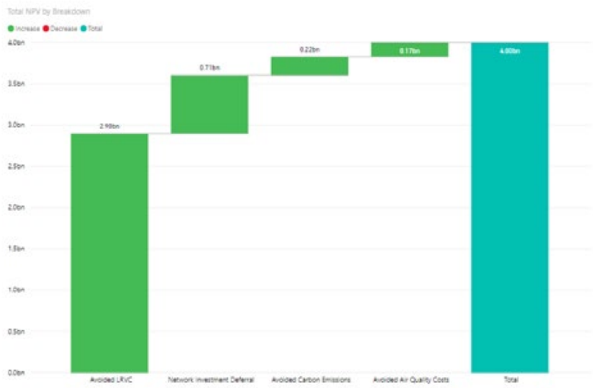


Figure 11: CBA breakdown – Price Signals – UK-wide implementation (£b 2019)



The business case assessment has demonstrated the numerous network and societal benefits provided through the interventions. These benefits include fuel cost avoidance, network reinforcement deferral, air quality improvements and carbon emission reductions.

The business case assessment has shown that it's cost-efficient to roll out the LED and Price Signal interventions at increased scale, such as to all SSEN customers or for the entire UK. Advancing these interventions would provide continuous all-year round load reductions and the report in Appendix 6 believes their potential implementation should be pursued.

6.2 Network Investment Tool – Business Case

The Network Investment Tool is a complete, stand-alone piece of software that can be used by DNOs to support the transition to DSO. The backend calculations are relatively fast and the Microsoft Excel-based user interface is easy to navigate, facilitates considerable modelling flexibility, and presents results in a familiar yet highly detailed and intuitive style. The tool provides consistency and efficiency to the functionality of existing LV design tools, clearly demonstrating to network designers and planners where and when overloads exist in specific LV networks, for both present and possible future patterns of demand and embedded generation.

The NIT also provides completely new functionalities, including the ability to compare the economic value of various solutions, including: traditional reinforcement and novel SAVE interventions, for dealing with uncertain future load growth. It is important to note that the functioning of the NIT is not tied to the particular form of the models on which it currently relies. That is, the NIT may be conceived as a 'wrapper' that can be lifted by other DNOs and the calculations applied to their own choice of customer demand model, economic assumptions and load-flow engine.

6.2.1 Summary of Module Functionalities

Table 6 below summarises the functionality of each main module, along with the relationship of these functions to existing DNO practices and the key benefits the modules bring.

Table 6: NIT Business Case

Name	Summary of Functionality	Relationship to Current Practices	Main Benefits Offered
Single Assessment	• Allows users to build LV network models (or load previously constructed ones), including customer connection points. Based on the network's geographic location, the Census Interface predicts the distribution of pre-defined customer types among these connected customers. It uses the resulting modelled demand patterns to calculate patterns of voltages and currents. • Transforms the voltage and current values into summaries of any overloading that is predicted to occur at specific locations on the network and presents this information as Excel tables.	• The basic functionality of this module already exists within network design teams, and the load flow engines are the same as already used by SSEN. • However, existing tools do not provide such an integrated and automated environment. • The time to build a new network model is comparable for this module and existing tools, as is the relatively short time required to run calculations. • Most current methods used by DNOs do not have anything analogous to the Census Interface that allows for the number of customers of different, types to be automatically calculated.	• The fully integrated nature of this module, the existence of the Census Interface, and the clarity of the interface means that the opportunities for human error are greatly reduced, consistency in approach is clearly auditable and accuracy may be increased. • Allows overloading, or near overloading thresholds to be defined by user for bespoke reporting.

Table 6: NIT Business Case (cont.)

Name	Summary of Functionality	Relationship to Current Practices	Main Benefits Offered
Future Assessment	• Allows users to review loading on a network, based on a specified season and/or type of day, and see how network overloads may gradually develop from year-to-year, given a user-constructed load growth scenario. • Presents in a highly detailed and granular way (i.e. feeder nodes and branches); the extent to which an intervention – SAVE or traditional reinforcement, would mitigate those overloads.	• As with single scenario, the basic functionality of the module already exists, but there is an advance in terms of the level of automation and integration offered by the NIT, e.g. the direct comparison of results with and without intervention, and presenting the first year that problems arise. • This automatic analysis and summary of year-on-year changes in congestion is novel. • The Census Interface is again completely unique in its ability to automatically account for location-based differences in the customer type mix.	• Clarity and flexibility in the construction of load growth scenarios. • A detailed clear presentation of precisely how a specified growth scenario would cause overloading problems, and the precise extent to which a chosen intervention would mitigate the overloads. • It can be used alongside the Multi-Assessment Module to provide analysis of the impacts of a specific solution proposed by the latter across all times of day and seasons.
Multiple-Assessment	• Allows user to define a set of up to four detailed load growth scenarios over coming decades. • Provides 3 coherent strategies for the timely and complete mitigation of resulting network overloads, differing in the assumed ability to forecast load growth, and whether or not SAVE interventions are allowed (in addition to reinforcements). Presents the chosen intervention sequence for each strategy/ scenario combination. • Calculates the cost of each intervention in the sequence chosen for each strategy/ scenario combination. Translates costs into a single NPV of all interventions.	• Can speed-up some existing processes, i.e. establishing the necessary size of reinforcement needed to deal with an overload, for a single scenario, rather than a potentially repetitive process of testing different sizes. • Has several completely new functionalities, such as the automated production of coherent strategies across decades and comparison of the NPV of traditional intervention and smart to compare their success.	• Integrated use of the Network, Customer and Pricing Modules, so that the economic value offered by specific interventions on certain customer types can be evaluated as a mitigation to the predicted overloads arising on specific network nodes or branches, as a result of a detailed load growth scenario. • Facilitates assessment of the relative economic merit of the full range of potential interventions in specific situations. Fast assessment of whether SAVE and storage can compete with reinforcement solutions • Ability to examine the robustness of certain intervention decisions against load growth uncertainties. • Enables maintenance of a live watch-list of circuits where interventions are likely to be 'triggered' soon, supporting forecasting and pro-active network management.

7

LESSONS LEARNT FOR FUTURE INNOVATION PROJECTS AND PROJECT REPLICATION

7 Lessons Learnt for Future Innovation Projects and Project Replication

SAVE adopted a rigorous approach to learning capture, utilising weekly teleconferences and monthly PPRB meetings, with a specific agenda item dedicated to 'learning capture'. Project partners were also required to submit monthly reports highlighting key activities with specific learning and dissemination capture and were given access to a shared project log to record ad-hoc learning. At the close of SAVE the project organised a post project lessons learned meeting to reflect on decisions and learning from across the project's lifecycle.

The SAVE project has captured learning throughout its 17 SDRC reports and annual PPR's. The project has captured headline learning and those items recorded in the project's learning log in Table 7 to Table 14 below (a full summary of learning outcomes can be viewed in Appendix 7). This is split between learning and how it influenced project thinking. Given overlap with project replication and to avoid doubling of text the points in bold are seen as especially influential for future SAVE type trial replication.

Table 7: Lessons Learnt – Project Management

Category	Ref	Learning Captured	Influence on project thinking
Project Management	1	Drawing on US experience the project identified instances where using surveys to disaggregate energy usage could act as a reasonable and cost-effective substitute for smart plugs.	Following failure of the projects smart plugs detailed in CR2, the UoS was able to support this learning with the use of TU diaries in re-design to their analytical approach.

Table 8: Lessons Learnt – Customer Engagement

Category	Ref	Learning Captured	Influence on project thinking
Customer Engagement	2	Some participants note more contact (more phone than anything) than anticipated as a reason for trial drop-out. If surveys can be carried out at install, they should be to minimise any fatigue.	In secondary rounds of recruitment used to boost SAVE's project population recruitment surveys were carried out alongside install. Surveys were also tested on SSEN staff and where possible cut-down in duration.
	3	When setting up initial (pre-trial) 'lesson learned events' (to gain insight from other NIC/NIA projects) the project the team was surprised by the appetite of attendees to travel significant distance to attend it. A key motivator for attendees was to capture as well as disseminate information as a result future such sessions should facilitate two-way flows of information.	The Project has structured its DNO roadshows to be 'knowledge sharing' events as opposed training based. The former providing a workshop-based approach to dissemination involving tailored agendas based on a preliminary meeting with opportunities to discuss SAVE compared and contrasted to other DNO's experiences/projects. This avoided a 'we talk you listen methodology' and encouraged greater audience engagement.
	4	Discussions around disseminating information on SAVE (in particular to domestic customers) highlighted potential for trial spoil.[31]	SAVE's dissemination plan looked to focus initial engagement at industry, academic and political audiences. Once final trials had completed the project increased efforts to engage domestic customers.
	5	**Significant improvements can be made in recruitment rates through having trained and experienced staff and easy to install kit.**	In 2015 the projects recruitment rates were 1/7. With the 'Loop' kit in 2017 the recruitment rates had improved to 1/5. As a result, the project worked to pursue consistency in field workers with field teams achieving recruitment rates of 1/4 participants by the end of the project.

31 SAVE's RCT trial was strictly managed to avoid any unintended bias in results or spill-over of information between trial groups. This was seen as a key element in allowing the projects results to be replicable of BaU engagement and hence accurately scalable.

Table 8: Lessons Learnt – Customer Engagement (cont.)

Category	Ref	Learning Captured	Influence on project thinking
Customer Engagement	6	Selecting field kit which can be easily/self-installed can save a project significant time and money in customer engagement, however it comes at the cost that it may be easy for customers to (accidentally) uninstall (i.e. unplug) the equipment.	**Switching monitoring devices to Navetas Loops greatly improved recruitment rates and speed on the SAVE project. Future projects should field test devices in a pilot to determine the best fit for project purposes.**
	7	TU diaries can seem intrusive to some people and limit response rates.	The project decided to introduce payment to update surveys on the project to manage fatigue and increase participant response rate to project surveys. The team also ensured initial scripting indicated the purpose of the diaries to support reasoning behind the exercise.
	8	Working with a small subset of field-staff can limit the ability of resource for ad-hoc field support. This contradicts [8] so a balance is needed in experienced and diverse staff.	**The project managed shortages in experienced field resource by video recording training from senior members of staff removing their dependency from bringing temporary/short-notice field-teams on the project (and minimising costs).**
	9	**When recruiting customers field teams should have customers spell their name out in order to ensure no mismatch in subsequent engagement material, especially if the project intends to issue cheques or pre-loaded debit cards.**	The project ensured rigorous CRM processes when issuing cheques to ensure customers with names spelt wrong or name changes could easily be managed.
	10	When paying customers via vouchers a clear tracking spreadsheet should be updated at routine intervals to avoid any error or reconciliation exercises.	**This may be eliminated in future projects by issuing a debit-style card which can be posted out and prepaid or only activated once participants have completed a survey or action.**

Table 9: Lessons Learnt – Energy Efficiency

Category	Ref	Learning Captured	Influence on project thinking
Energy Efficiency	11	Uptake from marketing based/reduced price bulbs was minimal despite signs of interest in bulbs (20% of customers visited the advertised website).	Customers may see benefits in EE, however there is a clear barrier to get customers to take action. By taking a pro-active approach to engagement this barrier can be broken down. **If a future trial does look to offer discounted EE marketing should make EE procurement as easy as possible and target a very large audience as take up will likely be low. Projects may also consider partnering with a trusted and well-known retailer to boost sales.**
	12	It was hypothesised that GU bulbs in kitchens would provide the biggest 'wins' in terms of peak load reduction. Field teams have discovered a lot of GU bulbs in kitchens are already LEDs and it's actually the bayonet/screw fittings that are older inefficient bulbs.	The project also adopted a JIT methodology to bulb procurement to minimise waste at the end of the trial period.

Table 9: Lessons Learnt – Energy Efficiency (cont.)

Category	Ref	Learning Captured	Influence on project thinking
Energy Efficiency	13	During the LED pilot, it was discovered there was the need for a logic check when recording data to ensure any bulbs replaced were lower wattage than old bulbs (i.e. human error in forms indicated the wrong bulb wattages).	SAVE deployed a pilot on 100 customers in the summer before TP2 to understand and test trial practicalities and systems before carrying out wider rollout to all 1000 households.
	14	Pro-active approaches to EE are far more effective than reactive approaches. By running DNO install of LED lights SAVE achieved a 7% reduction in peak demand across TG2.	Qualitative feedback revealed people often don't look at replacing EE appliances until needed. As a result, any reactive approach may be limited by such mindset. The success of the proactive (TP2) trials has been built into the NIT and SAVE BaU plans (Section 9).

Table 10: Lessons Learnt – Data Informed and Price Signals

Category	Ref	Learning Captured	Influence on project thinking
Data Informed and Price Signals	15	When running incentive-based trials it is important to understand that communications may need time to catch-up and as a result, incentives cannot be paid to all until this data has caught up. Understanding how long monitoring devices store data and setting a cut-off point by which communications need to have been 'received by' can ensure visibility is provided to customers.	The Navetas Loop device on SAVE stored data for up to 30 days, meaning that if a customer had been offline across an event day and came online 30 days after, the project team would then receive a bulk of data and could retrospectively understand if a participant passed an event. To strike a balance between allowing 'loops' time to 'catch-up' and engaging customers promptly; after an event the project noted upfront that results would be communicated within 2 weeks.
	16	Postal mailers may be seen as circulars/junk mail.	The project used **pink envelopes to make messaging stand-out and look different to 'junk'**. Participants noted remembering these envelopes at focus groups.
	17	**Engagement material should be designed to engage the whole family**. If those receiving the mailers aren't those responsible for most 'peak' activities, impact will always be low.	SAVE designed its engagement pack in TP2 to create more fun material that would stay around the home and be noticed by all family members, including: notepads, stationary and post-it notes.
	18	While education materials alone do not provide significant reductions in peak energy use, events trialled during education campaigns (as in TP1 and TP2) produce greater peak reductions than events trialled without educational materials (TP3).	**In BaU rollout of price signals it is advised that any engagement material gives a clear 'how' and 'why' in order to maximise customer response.**
	19	The shortest event also had the greatest response. Customers likely find it easier to reduce consumption for a couple of hours than for multiple days.	This should be noted when considering behavioural initiatives in managing flexibility and suggests that **'event' based initiatives may be most effective when targeting a short period of time.**

Table 10: Lessons Learnt – Data Informed and Price Signals (cont.)

Category	Ref	Learning Captured	Influence on project thinking
Data Informed and Price Signals	20	Analysis indicated that the strongest response was generally observed in households primarily heated by 'other' fuels (although it's very likely these households supplement with electric heat), and by households primarily heated electrically.	This shows that at least some of the reduction seen is from heat sources and may indicate that households with electric heating have more ability to shift their load. DNO's should continue to assess this alongside electrification of heating as this may increase the potential achievable load reduction from DDSR.
	21	There were not significant differences between the group that received an incentive and the group that did not during events. In most events, the incentive group had only slightly higher reductions. Evaluation also revealed that customers offered an incentive may increase demand outside of event periods.	During flexibility events, price signals are unlikely to represent good value for their additional cost. Getting the behavioural messaging right could be more cost-effective and achieve a similar level of load-reduction. Price signals may also lead to increased loads outside of event periods. Careful structuring of incentives and communications should be undertaken when offering incentives.
	22	Building on reference 21 above where ongoing behaviour change is required a price signal may be required.	SAVE's banded price signal trials showed some longevity to impact. Longevity was greater when running an 'opt-in' based initiative than 'opt-out' as the reduced subset of opt-in customers are more engaged.
	23	One of the ways in which the TU diaries identified people avoided peak was through avoiding being in the home.	**Enticing customers to stay out of the house during critical peak periods may result in even larger peak reductions than asking them to shift or cut consumption. For example, a DNO could partner with local businesses to offer discounted activities for specific days or times.**

Table 11: Lessons Learnt – CEC trials

Category	Ref	Learning Captured	Influence on project thinking
CEC trials	24	The project identified an issue of 'energy literacy' (i.e. the usage of appliances in the home) which needed addressing in order to meaningfully engage communities.	The trial learned that simple and visual information was most effective in supporting energy literacy. This material is available to be converted into a generic Energy Literacy toolkit and/or branded material for use with other communities.
	25	Cooking has been noted in previous projects (and was found in SAVE) to be an activity that people are less willing to shift. By engaging customers not with the energy saving of shifting cooking but the time saving of prepping earlier and using slow cookers more people were receptive of the benefits of shifting cooking activities.	**Where activities are inflexible to shifting, think what motivators (other than energy) may encourage behaviour change and/or facilitating technology which can support this. A focus upon cooking and food can be a valuable catalyst in shaping energy efficiency campaigns aimed at peak reduction.**

Table 11: Lessons Learnt CEC trials (cont.)

Category	Ref	Learning Captured	Influence on project thinking
CEC trials	26	In order to build trust and reason for communities to engage, utilities need to 'earn the right' to engage through first listening to and supporting communities on their own agendas	The community coaching trials were designed to spend TP1 'embedding' a coach, then 'building' relationships before 'sustaining' change. Future customer and community engagement should ensure customers are listened to before discussing network needs.
	27	Having a trusted messenger is crucial to effective communication. Within the CEC trials building a local brand with the communities was particularly effective bringing letter engagement rates from under 20% when DNO branded to over 50% when community branded.	**DNO's should look to partner with trusted and local organisations to maximise impact of DDSR initiatives.** SAVE trialled this with EST in a joint engagement mailer in its TP3 BaU engagement campaign.
	28	Engagement with stakeholders should take place at different levels within an organisation based on project phasing. Advanced stakeholder engagement shouldn't just identify organisation but also roles within them and when they'd best be engaged.	**Within the community coaching trials initial engagement with those in strategic positions in organisations was important. Later in the trial's engagement with more operational staff to support 'on-the-ground' was more important.**

Table 12: Lessons Learnt – Analysis

Category	Ref	Learning Captured	Influence on project thinking
Analysis	29	In reviewing other innovation projects SSEN note a mixture in standards of how statistics are evidenced and reported. It is advised that future innovation projects adhere to a minimum, best-practice standard of statistical rigour to allow for accurate and transparent comparison of project outcomes.	SAVE has adhered to upmost rigour in reporting statistical findings. Confidence intervals are reported with confidence levels clearly stated. In addition, the results obtained from the trials were clearly identified as statistically significant in the reporting where applicable.

Table 13: Lessons Learnt – Customer Modelling

Category	Ref	Learning Captured	Influence on project thinking
Customer Modelling	30	**Analysis showed that the winter peak demand in the SAVE sample households occurred on a Sunday, with the peak demand larger and marginally earlier than the weekday peak (6pm as opposed to 6.30pm). See Section 3.2.1 in SDRC 4.**	**This finding contrasts with the assumption that the domestic winter peak occurs during a weekday and is important to account when modelling LV networks. If networks are modelled for weekday peaks only, they may miss the higher loads experienced during the Sunday peak. This could affect the flexibility mechanisms used to manage a constraint. In networks dominated by domestic customers, Sundays should be modelled when considering winter peak cases. LV monitoring should be used to validate modelled data.**
	31	Modelling of the SAVE household data revealed the three highest ranked predictors of evening peak hours consumption were: household size, dwelling size and primary heating fuel. This contrasts with existing customer categorisation by characteristics such as income.	**The SAVE CM typology provides a greater diversity of customer loads than those currently in use (e.g. those from ENA P5 guidance).**
Customer Modelling	32	The SAVE sample included a small proportion of non-gas heated households (under 10%) which exhibit a large diversity of load profile shapes. While synthetic profiles were employed to meet project objectives, limitations were noted in how well these profiles represent these customers.	**As mains gas becomes less prevalent as the primary fuel for heating, DNOs should look to compliment the load profiles provided by the SAVE CM with additional profiles constructed using representative data from households using electricity as primary (and secondary) heat source.**

Table 14: Lessons Learnt – Network Investment Tool

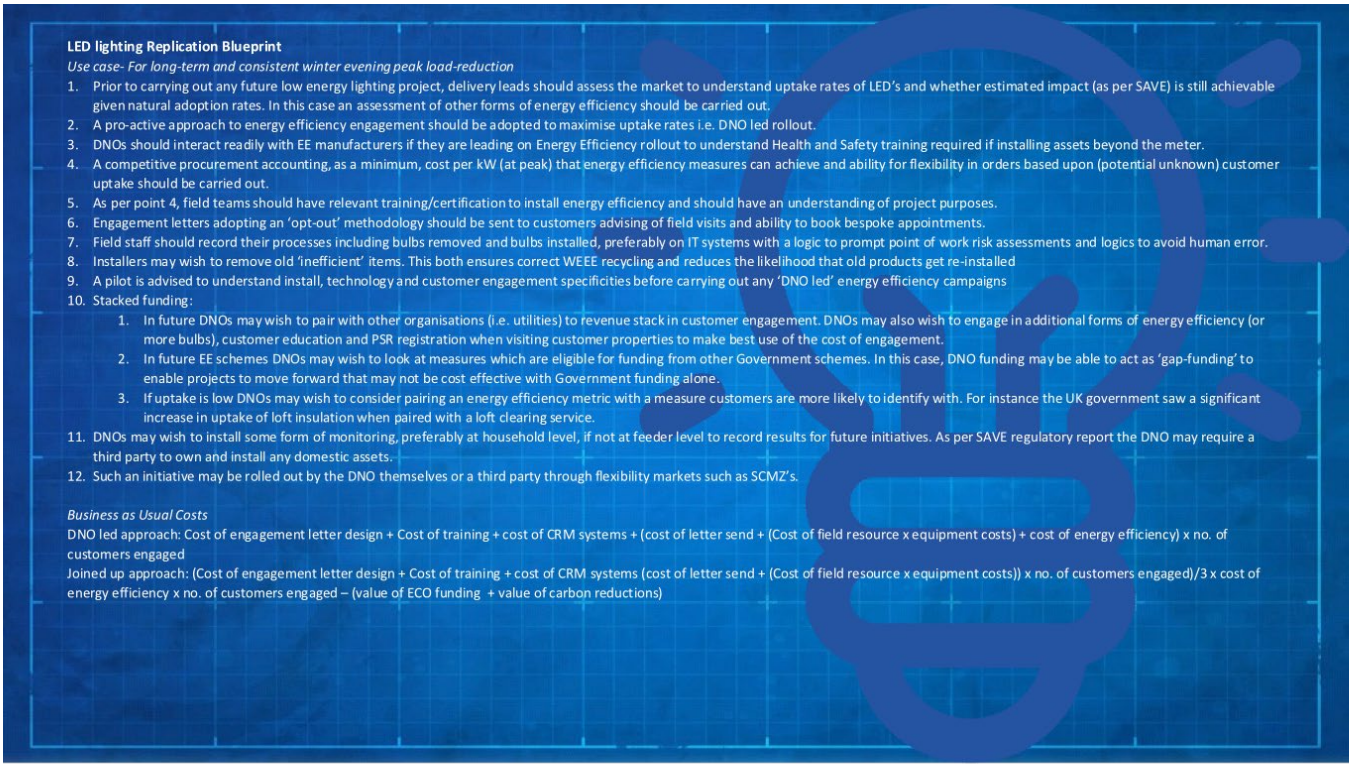
Category	Ref	Learning Captured	Influence on project thinking
NIT	33	A NIT can help network planners pro-actively identify network constraints and the costs associated with managing given networks over time. Regret analysis may then be used to minimise risk with given investment strategies given uncertainty in load-growth scenarios.	The NIT provides a portfolio of scenarios vs strategies to give an overview of potential future worlds- a pathway of least regret is then suggested using least regret analysis. In future DNO's should look at understanding how optionality value may be used to optimise decisions under uncertainty.
	34	The NIT suggests SAVE interventions can be used to cost-effectively manage thermal constraints on case-study networks deferring reinforcement for up to 2 years (depending on load-growth scenarios).	SAVE interventions should be considered as flexible alternatives to traditional reinforcement and should be able to compete with traditional reinforcement. SSEN is supporting this market through its SCMZs.
	35	When running LCT uptake scenarios through the NIT, certain LCT's may cause peaks in demand to shift outside of the 4pm to 8pm period. (CLNR EV profiles were noted as a key driver for shifting peak).	Future trials and flexibility mechanisms should look to understand load-shifting capabilities as peak change from outside the traditional evening peak period.

Table 14: Lessons Learnt – Network Investment Tool (cont)

Category	Ref	Learning Captured	Influence on project thinking
NIT	36	SAVE interventions are most likely to be part of an optimal investment strategy when load-growth is low, and the network is heavily loaded. SAVE interventions may also be more effective in areas where electric heating is already present. SAVE interventions are less likely to be part of optimal investment strategies where load growth is high (learning detailed in SDRC 8.2).	Where SAVE trials are cost-effective to understand common themes which may highlight sites for further assessment of BaU rollout of initiatives.
	37	Software delivery requires bespoke project management processes to capture required change and early visibility to ensure clarity on requirements	**Adopt best practice software delivery standards with regular 'sprints' in delivery to keep the software development moving to plan and requirements.**
	38	The NIT's backward looking: 'all knowing' strategy can be used to show the benefits of investing in a large asset early on (sometimes at the cost of NPV) outweighs the benefits of installing multiple assets at minimum scheme (as per current regulation), particularly in the presence of significant load growth.	**The project recommends that Ofgem look at regulation around minimum scheme in the presence of LCT growth and consider derogations where forecasts predict significant load-growth and a positive cost-benefit for investing in larger assets. The NIT may be one such tool which could be used to justify such an investment.**

The learning from Table 7 to Table 14 has been built into delivery blue-prints for each of SAVE's main work packages to support project replication, anticipated costs and future business cases, these are displayed in Appendix 8, an example of their content, for the LED trials, is shown in Figure 12 below.

Figure 12: LED Blueprint



LED lighting Replication Blueprint

Use case- For long-term and consistent winter evening peak load-reduction

1. Prior to carrying out any future low energy lighting project, delivery leads should assess the market to understand uptake rates of LED's and whether estimated impact (as per SAVE) is still achievable given natural adoption rates. In this case an assessment of other forms of energy efficiency should be carried out.
2. A pro-active approach to energy efficiency engagement should be adopted to maximise uptake rates i.e. DNO led rollout.
3. DNOs should interact readily with EE manufacturers if they are leading on Energy Efficiency rollout to understand Health and Safety training required if installing assets beyond the meter.
4. A competitive procurement accounting, as a minimum, cost per kW (at peak) that energy efficiency measures can achieve and ability for flexibility in orders based upon (potential unknown) customer uptake should be carried out.
5. As per point 4, field teams should have relevant training/certification to install energy efficiency and should have an understanding of project purposes.
6. Engagement letters adopting an 'opt-out' methodology should be sent to customers advising of field visits and ability to book bespoke appointments.
7. Field staff should record their processes including bulbs removed and bulbs installed, preferably on IT systems with a logic to prompt point of work risk assessments and logics to avoid human error.
8. Installers may wish to remove old 'inefficient' items. This both ensures correct WEEE recycling and reduces the likelihood that old products get re-installed
9. A pilot is advised to understand install, technology and customer engagement specificities before carrying out any 'DNO led' energy efficiency campaigns
10. Stacked funding:
    1. In future DNOs may wish to pair with other organisations (i.e. utilities) to revenue stack in customer engagement. DNOs may also wish to engage in additional forms of energy efficiency (or more bulbs), customer education and PSR registration when visiting customer properties to make best use of the cost of engagement.
    2. In future EE schemes DNOs may wish to look at measures which are eligible for funding from other Government schemes. In this case, DNO funding may be able to act as 'gap-funding' to enable projects to move forward that may not be cost effective with Government funding alone.
    3. If uptake is low DNOs may wish to consider pairing an energy efficiency metric with a measure customers are more likely to identify with. For instance the UK government saw a significant increase in uptake of loft insulation when paired with a loft clearing service.
11. DNOs may wish to install some form of monitoring, preferably at household level, if not at feeder level to record results for future initiatives. As per SAVE regulatory report the DNO may require a third party to own and install any domestic assets.
12. Such an initiative may be rolled out by the DNO themselves or a third party through flexibility markets such as SCMZ's.

Business as Usual Costs

DNO led approach: Cost of engagement letter design + Cost of training + cost of CRM systems + (cost of letter send + (Cost of field resource x equipment costs) + cost of energy efficiency) x no. of customers engaged

Joined up approach: (Cost of engagement letter design + Cost of training + cost of CRM systems (cost of letter send + (Cost of field resource x equipment costs)) x no. of customers engaged)/3 x cost of energy efficiency x no. of customers engaged – (value of ECO funding + value of carbon reductions)

7.1 IPR

SAVE recognises the importance of knowledge share between DNO's and across industry. The project has conformed to IPR governance with newly generated IPR recorded in the projects 12 Project Progress Reports.

8

PLANNED IMPLEMENTATION

8.1 Domestic Demand Side Response

Following the success of SAVE's trials, in particular TP2 of the LED lighting trial (DNO-led EE engagement) identifying an up to 9% reduction in peak demand [26], the project team have worked with the business and government[32] to identify a BaU route to deploying similar initiatives. Two key routes to market are being investigated: Joint Utility Working and SCMZ.

8.1.1 Joint Utility Working

Whist notably successful at reducing peak demand, SAVE's DNO-led EE was a costly approach to engagement (see Section 2.2). Drawing upon learning from the CEC trials the project identified numerous reasons for both local and national stakeholders engaging households around similar themes to those a DNO may wish to discuss. Given 90% of the cost of the DNO-led EE trial was spent on customer engagement the project combined learning from the two-trials to design a joint utility approach to EE rollout.

By rolling out electrical efficiency alongside water efficiency and gas safety a DNO may be able to target EE rollout at (up to) a third of the engagement costs and provide a clearer, more concise message to customers. Likewise given the similar drivers around PSR sign-up and fuel poverty, the utilities have an opportunity to revenue stack in their business case, not just identifying the benefits of reduced load (or water usage or safer homes) but social factors too. An example of a cost-effective business case for this is given in SDRC 8.3, Section 7.2.

SSEN is in discussions with Thames Water, Southern Water, Cadent and SGN around targeting such initiatives. Southern Water have identified a large amount of water efficiency visits they will be carrying out under OFWAT legislation, SSEN are working on a plan to 'piggy-back' joint messaging and LED lighting onto these visits in constrained areas of the network.

8.1.2 Social Constraint Managed Zones

In assessing why DDSR mechanisms were not being offered within flexibility markets SSEN, using expertise from SAVE, identified 3 key barriers to market which were limiting the uptake of such solutions. This included: visibility and complexity, procurement and payment, and social costs and benefits.

Through SAVE, SSEN recognised that the organisations best placed to deliver EE based initiatives may well be local and SME type organisations. These organisations are typically resource scarce and risk neutral. As a result, navigating the complexity of flexibility markets and procurement mechanisms can pose a significant barrier to entry. Likewise, and as we have shown in Section 6, a significant amount of value from DDSR is in the additional social benefits through such initiatives.[33]

SSEN have therefore updated, expanded and amended their flexibility programme (Constraint Managed Zones) to encompass Social Constraint Managed Zones (SCMZ). An SCMZ looks at how the DNO can stimulate local communities and organisations to work together (stacking benefits as per CEC trials) more effectively to deliver EE and other DDSR initiatives to DNOs. SSEN is working closely with NEA and Navigant to support such initiatives and is using learning from SAVE to shape and provide examples of methods which may be used in flexibility tenders. To date SSEN has received 10 seed funding applications to its SCMZ scheme. More information and details on SCMZs can be found at: https://www.nea.org.uk/technical/scmz/.

8.2 Network Investment Tool

The NIT has been rigorously tested with planning, connections and commercial teams across both high and low voltages to assess where the tool speeds up processes, improves accuracy and provides new functionality to the business. In order to build a business case for the NIT internally the project team took a three-step approach: 1) what parts of current planning processes need to evolve to be DSO ready? 2) where does the NIT functionality plug this? 3) what might be needed to evolve the NIT to be BaU ready in delivering this bespoke functionality most effectively. A summary of the value the NIT can provide to different business units are given below (the scenarios mentioned are further detailed in SDRC 8.5/6).

LV Connections – The NIT (through its single scenario) can provide LV connections teams the ability to see the shape of load on their networks through a single and automated process. This 1) minimises human interaction and gives clarity in the processes needed; and, 2) shows when (during the day or specific seasons) there may be excess capacity on the network but providing a 24-hour load-profile as opposed more binary MDI readings.

LV Network Planning – The NIT (through its future scenario) will provide a forecast of what a network may look like under future scenarios. This will allow an LV network planner to look into the future and understand when a given network is likely to reach overload under specified levels of LCT uptake. This will also inform the type of issue (thermal or voltage) expected, where on a substation (or feeder) this may occur and to what level on a year-by-year break-down. It is intended this will improve forecasting capabilities for RIIO ED2 spend.

This functionality also allows a user to run the effects of SAVE interventions through the NIT to see how they might affect future demand load and hence the value an intervention can bring.

32 SAVE has provided feed-in to three BEIS calls for evidence and regular updates on thinking around the future of ECO.

33 Initial work was carried out by NEL looking at means of quantifying social benefits in DDSR. SSEN has progressed these conversations with BEIS where significant social benefit exists in reduced carbon emissions.

(Through its multi scenario) the NIT uses the PM to provide costs for a range of different intervention strategies. It also uses least regrets style analysis to help network planners minimise financial risk on the network where multiple futures may be possible. The NIT does this by assessing a range of strategies against a range of scenarios and identifying optimal outputs (see SDRC 8.2). Where the NIT assesses smart (SAVE) interventions against traditional reinforcement it can be used to inform thinking as to whether flexibility solutions are likely to be cost-effective against traditional solutions, as per the ENA's commitment to Secretary of State, Greg Clark [3].

HV Network Planning – The NIT (through its HV interface) can provide forecasts of what future loading may look like on a given substation given a range of LCT scenarios and will then tell a planner whether an SCMZ is likely to be applicable to noting the expected impact of SAVE interventions on the substation in question. This interface may be used to inform future SCMZ schemes.

RIIO ED2 strategy – by running the NIT over a number of 'case-study' substations the DNO can start to build up a picture of the amount of reinforcement required in the next price control and its potential costs. With further development[34] it is intended the NIT could be bulk run across LV networks to provide a full overview and 'watch-list' of LV substations to pro-actively manage networks (see SDRC 8.5/6).

EV strategy – Can use the CI developed as part of the NM to understand current vehicle ownership and type of housing tenure- mapping this to the network using the same methodology of the NIT gives better EV forecasting, especially at LV.

Future Commercial – Through using the least regrets analysis within the NIT DNOs are beginning to understand the implications on the future of taking one decision over another (with significant forecasting uncertainty) and hence a means of quantifying what has become known as optionality value. Consultants TNEI build on this approach in their 2019 paper "The Value of Flexibility when the Future is Uncertain" [8].

8.3 Stakeholder Engagement

Stakeholder engagement processes have been closely reviewed and updated building on learning from SAVE, specifically within the CEC trials. Through these trials, we are now able to better recognise the differences in communities and the approach required to engage people on the free help we have available. Our recording of PSR data and data around which areas have the largest populations of eligible customers has improved; we have therefore placed a renewed focus on engaging in areas where lots of customers are eligible for the PSR but not yet registered, known as the PSR Gap. Across SSEN we now have over 60% of eligible households registered for our Priority Services, so we are able to help them better and quicker during power cuts.

Another such point that is already proving to be successful is that working with trusted third-party intermediaries often produces greater results than engaging with customers directly.

To give two further examples of where learning from SAVE is being employed:

- In central southern England area, building on the CEC approach to 'stackable benefits' particularly around energy efficiency advice, SSEN are now working with the Centre for Sustainable Energy to help people being discharged from hospital with energy efficiency advice. This ensures they don't go home to cold damp properties which could lead to a return of their illness and ultimately readmission. This is an example of a project providing valuable help that would have been very difficult to achieve without partnership working approaches learned through SAVE.
- An example from the north of Scotland area is our funding four Energy Efficiency Advisors who work for Citizens Advice Scotland (CAS). We recognise that through CAS the DNO will be able to help more of our customers out of fuel poverty than if we were to attempt it ourselves. SAVE showed that customers are more likely to talk about their circumstances with a CAS adviser than with our teams, accepting this allows us to provide such help far more efficiently.

Finally, by utilising outputs from the CM the SAVE project team have also added DDSR initiatives to SSEN's vulnerability mapping tool (see Appendix 2.1); a tool used by stakeholder engagement to understand and visualise areas of deprivation and support in 'stacking' benefits across different streams of work.

34 SSEN is currently integrating its 'Electric Office' programme, it is intended that integration with the outputs of Electric Office may allow for automation of the NIT's network build process and hence the tools run capabilities.

8.4 Behavioural techniques and nudges

In designing engagement strategies for both the data-informed and CEC trials, the project team identified the value of deploying different forms of behavioural messaging. SSEN has recognised the potential for deployment of these techniques within other areas of work, whether it be in writing to customers or sending out corporate messages to employees. Lazlo Bock in writing about 'google' notes how Nudge techniques are used in other industries to improve security, productivity (particularly around new hires), and participation in pension schemes [9].

By thinking EAST (easy, attractive, social, timely) [6] and NUDGES (iNcentives, Understand mapping, Defaults, Gain feedback, Expect error and Structure complex choices) [12] when sending out communications DNO's can improve their customer and employee engagement with almost no additional cost.

8.5 Continual learning capture

The value of data in terms of trial response will be of value to allow DNOs to continue to grow and build the NIT across 'non-SAVE' initiatives. By ensuring relevant information is collected when running future trials DNOs can continue to build upon and expand the outputs of the NIT by, for example, building on the SAVE data with a wider geographical spread of data.

Building on Section 8.4, continual learning capture will be key to understand which techniques work in which circumstances. To quote the economist Richard Thaler "field based trials are perhaps the most powerful tool we have to put the evidence in evidence-based economics" [13].

8.6 Business as Usual Delivery Documents

The project's three business as usual delivery documents will support DNOs in the rollout of SAVE initiatives. The regulatory report highlights to DNOs wishing to rollout initiatives using the SAVE methodology (as Section 7) the considerations to ensure they remain within industry governance [4]. The operational report provides an avenue to integrating a NIT within internal planning processes [27]. The commercial report provides industry and government insight into how future commercial systems may look and the anticipated impact of SAVE interventions within these frameworks [25].

9

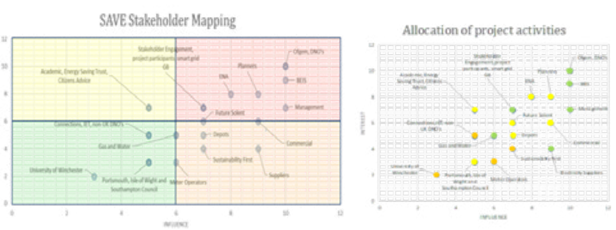
LEARNING AND DISSEMINATION

9 Dissemination Strategy

The SAVE project dissemination strategy was owned by a dedicated knowledge dissemination team working across SSEN's innovation portfolio to give a strategic view across industry and to identify the most cost-effective channels for engagement. The initial dissemination strategy on SAVE was created between the PM and the knowledge dissemination team and was managed and updated on regular monthly calls to respond to new findings/opportunities.

Initial scoping exercises included layering stakeholder mapping against project phasing and mapped mechanisms through which the project might choose to disseminate. A copy of the projects initial stakeholder map is shown to the left of Figure 13 below.

Figure 13: Stakeholder mapping



The stakeholder map was used alongside project timelines and industry opportunities (identified by the knowledge and dissemination manager). As this developed, a RAG tracking system was used to ensure each key stakeholder was engaged, kept satisfied and given the appropriate platform to shape and/or learn from the project.

A dissemination log was retained throughout the project and can be found in Appendix 10. Partner dissemination was discussed and recorded monthly at PPRB meetings. In total the project recorded over 80 dissemination activities, not including the community events as part of the CEC trials. Of these activities; 27% were external events attended by the project team, 22% were events organised by the project team and 14% were media publications.

Initial Dissemination Activities – The SAVE project team carried out extensive literature review of wider DNO and industry led DDSR. SDRC 1 provides an overview of this literature review with reference to over 200 projects or documents, notably including: CLNR, LCL, NTVV and My Electric Avenue. Project partners, NEL also carried out semi-structured interviews with an introduction to SAVE with the likes of: WPD (Less is More and Sola Bristol) and ENW (Power Saver Challenge).

Dissemination throughout project delivery – Enacting the dissemination strategy developed on SAVE required close customer relationship management and suitable processes for the project team to co-ordinate engagement activities. Across project partners this was co-ordinated by the PM in monthly project reports to support PPRB meetings. The SAVE PM then reported back in to SSEN's knowledge managers to support wider strategy, potential for additional opportunities and portfolio cross-over.

SAVE limited its 'public' online presence (outside of industry and professional networks) up until January 2019 when trials finished. Given SAVE's RCT design, its methodology looked to minimise wider project understanding for different trial participants so as not to unfairly influence the projects control group. Any interaction or unnecessary education of trial participants could result in trial spoil (as control participants may respond by acting 'abnormally') or drop-out (i.e. if one group understands that another group is receiving financial incentives whilst another is not). As a result, when trials did finish the project increased its online presence through social media channels (twitter stats can be found in Appendix 10.1). and the creation of a project website.[35] The website includes an overview of the project methodology, trial findings, energy saving tips and materials, PSR information, next steps and project reports. The website provides a landing page for customers (including project participants), industry, government and academia to discover the project, pledge their energy efficiency targets and access its findings. Since launch on 6/6/19 the website has been recording an average of 140 customer visitor's month.

While a full list of dissemination events is contained in appendix 10, this Section will look specifically at engagement with the stakeholder categories identified in the project bid document, notably: customers, industry (including DNOs), academia and government.

Customers

SAVE customers were engaged throughout the project, the level of this engagement varied depending upon the trials they were sampled/opted into. For the project's control group this engagement was minimised to update surveys and annual project updates (see appendix 1.1.2) until trials ended in January 2019. Data informed, price signal and LED trial participants experienced marginally more engagement through their trials. Materials used to engage these households can be viewed in SDRC 8.3 and SDRC 8.4/7.

A small selection of data informed and price signal participants were also invited to participate in annual workshops (one after TP1 and one after TP2 to inform subsequent trial periods). The strategy behind these focus groups are reported in SDRC 3.2. Outputs of 'events 1 and 2'

35 https://save-project.co.uk/

held after TP1 are available in chapter 3 of the SDRC. 'Events 7 and 8' were carried out with 18 households across two days in April 2018; the day's agenda and presentations given are recorded in Appendix 10.2.

A final survey was carried out with dynamic pricing trial customers in January 2019 to understand how the trials might have changed behaviour and willingness to participate in future. This survey built upon the survey carried out on LCL with customers participating on their TOU trials and is analysed in appendix 10.3.

The CEC trials received a far greater level of engagement, as highlighted by the summary of activities displayed in Figure 5 (a more in-depth overview given in SDRC 8.8). The CEC trials also facilitated quarterly stakeholder engagement workshops, often attended by members of the community alongside representatives from the utilities, local councils, universities and housing associations. Minutes were recorded for each meeting and actions circulated. Like the other trials the CEC trials hosted several focus groups of which events: 3, 4 and 5 are recorded in SDRC 3.2. Event 6 is summarised in appendix 10.2 and event 10 (one year on) is summarised in appendix 2.4a.

Industry
The Project has maintained close engagement with other DNOs both in design of SAVE trials and in order to support DNOs in their own DSO strategies. Alongside annual attendance and presentations at the LCNI conference (2019 [scheduled], 2018, 2017, 2016, 2015, 2014), the project has organised frequent updates with innovation teams, notably including:

- UKPN and Energywise – The SAVE team have had regular catch-ups as the project ran in parallel with UKPN's Energywise. UKPN also hosted the SAVE team to present at their closedown event in July 2018. The two DNO's have utilised this basis to work together on sharing internal processes and feeding into wider government EE strategy i.e. calls for evidence.

- NPG and ACE – Much like Energywise, ACE ran in parallel with SAVE also looking at DDSR. SAVE's CEC trials were engaged closely in sharing learning with NPG's ACE project. SAVE also received shared updates from GenGame on the project's progress and trial outputs

- ENW and Voll 2 – SAVE's learning into customer motives, community behavior and social value has been able to feed into the Voll 2 project through expert advice in semi-structured interviews- this will feed directly into the project's final reporting. SAVE also supported ENW through feed-in to their bid for Power Saver Challenge 2.

The SAVE project also ran and organised a series of DNO Roadshows offering a tailored agenda to discuss the SAVE project and more specifically training in the project's NIT. NIT training was accompanied by a user manual, guiding engineers in their use of the software to support BaU integration, a copy of this can be viewed in Appendix 1.6.4.

To date Roadshows have been held at: UKPN, NPG and SHEPD. Feedback scores across DNO's can be viewed in Appendix 10.4 on average 66% of attendees strongly agreed with the statement that the roadshows had been relevant with the remaining 34% agreeing with the statement.

Amongst regular updates and close engagement with a vast array of industry stakeholders including: gas and water utilities, EST, carbon trust and NEA (a more definitive list can be found at: https://save-project.co.uk/stakeholder-engagement/) the project (as outlined in the bid) gave a particular focus to suppliers. A summary of these activities can be read in Section 2.4.

Internally the project team have reported into SSEN's internal ELT meetings bi-annually to provide project updates and alongside ongoing engagement across planning, connections and stakeholder engagement teams have held annual bespoke events to engage the wider business on SAVE's progress and different business units that could make use of the project learning (this has fed into Section 8).

Academics
Academic partners UoS led on engagement within academia, presenting elements of the SAVE project including trial design, results and customer modelling at a number of UK and international conferences:

- 7th World Congress of the International Microsimulation Association, Galway, Ireland (2019) [15]

- 2019 International Conference on Renewable Energy, UNESCO, Paris [16][17]

- 2019 International Conference on Energy and Cities, Southampton, UK [18]

- 2018 International Conference on Energy and Environment of Residential Buildings, Wellington, New Zealand [19]

- 5th World Congress of the International Microsimulation Association, Luxembourg (2015) [21]

The SAVE project was also presented by the University at a number of other academic, industry and policy forums, including:

- Exhibition at the All-Party Parliamentary Group for Renewable and Sustainable Energy Annual Conference, Houses of Parliament, London (July 2018);
- SAVE project highlighted and poster displayed at Energy in the City Roadshow, Southampton, UK (9th November 2017);
- Poster presented at International Symposia on Next Generation Infrastructure, London, UK (11-13th September 2017);
- 'Lightning talk' to UoS 'Clean Carbon' strategic research group event, University of Southampton (May 2017).
- Presentation of data management and analysis at UCL/UKDA workshop (March 2017)

A number of journal papers related to the SAVE project trials, including aspects of trial design, trial results and modelling methods are at various stages within the publication process. Including: design and implementation of an RCT in demand response [22]; three papers on trial findings (LED lighting upgrades, data-informed and banded pricing interventions) and three papers on modelling methods (spatial microsimulation). Notably, a paper on the subject of best practice in reporting trial findings has been accepted for publication in the journal Energy Research and Social Science [23]. The University have produced an online mapping tool to visualise results from the CM, allowing users to explore the model outputs within the project geography (by Census output area) [24].

The University also hosted an academically targeted SAVE closedown event as a special parallel session of the International Conference on Energy and Cities on 10th July 2019. Presentations were given providing greater detail and insight into the procedures behind the projects trial design and recruitment, evaluation of the interventions and the modelling conducted. The event was attended by 40 international academics, industry professionals, local policymakers and third-sector organisations over 2 days.

The SAVE project has also developed a particularly close relationship with the University of Reading, supporting and feeding in to their 'DeepRed' project and presenting at the projects closedown as well as procuring their support in the projects commercial report on core consumption [25].

Government

The customer and carbon centric nature of SAVE has positioned the project with both a strong DNO business case but also a far wider reaching social and politically relevant business case. The SAVE project bid notes: "In this project SEPD will very actively facilitate... aspects of the Carbon Plan in a manner that produces direct network benefits and financial benefits to customers."

SAVE has looked to achieve this throughout its trials by maintaining a close working relationship with BEIS, Ofgem and local constituencies to provide both, supporting evidence to macro-level political direction but also in shaping the project within the boundaries of its scope to meet industry changes and direction from governance.

The SAVE project held three events in the houses of parliament (November 2017, November 2018 and June 2019) with a more political focus to share updates and outputs from the SAVE project. Attendees included Shadow Energy Minister, Alan Whitehead, BEIS and Ofgem.

Figure 14: Shadow Energy Minister, Alan Whitehead opening SAVE's HoP event, November 2017 (Photo: Tom Rushby)

The SAVE project manager has held monthly meetings with Ofgem's designated project officer throughout the duration of the project. The project praises Ofgem in the pro-active attitude of their officers who, for example, supported in: discussions around trial design in TP3 (setting up meetings with experts within Ofgem to gain insight into shaping a future dynamic tariff), facilitating dissemination activities at Ofgem (SAVE project manager presented with SSEN charging and DSO leads in April 2019 to showcase the projects findings, BaU integration and policy relevance[36] and direction on project governance.

36 This event and follow-up discussions significantly progressed thinking around SAVE's core capacity report, which was delivered in June 2019.

SAVE has built a strong reputation with teams at BEIS to showcase the capabilities of DNOs in supporting the UK's transition to more efficient homes. Regular meetings around how DNO's are using SAVE learning, both in SCMZs, as well as how government might leverage this have been and continue to be ongoing with BEIS. BEIS most recently quoted the SAVE project as an example of how EE can support network operation in its "Facilitating energy efficiency in the electricity system" CfE [1].

SAVE Closedown Event

On 6/6/19 SAVE held a 2-part closedown event in Westminster. Part 1 of this event provided an overview of the SAVE project's trials and outputs, sharing how the project had performed against its intended aims and objectives as well as how this learning could be implemented by DNO's and wider industry. A full agenda for the day can be found in Appendix 10.5. Part 1 of the event was attended by 52 participants, including: DNOs, regulation/government academics, utilities, consumer focus groups and consultancies.

Throughout the event the project team used Slido to answer questions, prompt audience participation and record feedback. When asked whether attendees of the event thought they could implement the learning from the SAVE project 90% of attendees noted they could. Attendees were also asked to rate the event out of 5, with an average rating of 4.2 out of 5. A full summary of Slido results can be found in Appendix 10.6.

Part 2 of the SAVE closedown event was held at 'Portcullis House' as a limited attendance, politically focused evening event (see agenda in Appendix 10.5). The event, sponsored and opened by Shadow Energy Minister, Alan Whitehead, provided an initial, 'project focused' session, recapping and emphasising the political relevance of some of the SAVE outcomes. This involved a presentation from the SAVE project manager (see appendix 10.7) and a panel session with project partners. The second half of the event included presentations from BEIS and SSEN's director of DSO on how SAVE is influencing thinking across industry and how learning is being implemented across government and industry. The event then facilitated a 'power-panel' consisting of: BEIS, Ofgem, ENA, CEO of EST, CEO of NEA and the Director of DSO at SSEN.

Industry Awards

In March 2019 SAVE was awarded winner of: Stakeholder Engagement Initiative of the Year at the Network Awards. Alongside this SAVE was shortlisted as a finalist in:
The Energy Awards 2018, Utility Week Awards 2018, The Institute of Customer Service Awards 2018 and the UK Energy Innovation Awards 2019.

10

KEY PROJECT LEARNING DOCUMENTS

10 Key Project learning documents

The project has published 17 SDRC reports, 9 PPRs and 3 BaU delivery support documents. SAVE has delivered all SDRCs outlined in Section 9 of the project bid document. The project combined SDRC 8.4 (data-informed engagement trials) and SDRC 8.7 (Price signal trials) to form one succinct SDRC 8.4/8.7 (data informed and price signal trials) given the parallel running of these methods. The project also split SDRC 8.5 (Customer Model) across both SDRC 7.3 (Network Model) and SDRC 8.6 (Network and Customer Model) to create SDRC 7.3/8.5 (Network and Pricing Model- evidence report) and SDRC 8.5/8.6 (Customer, Network and Pricing Model- learning report).

The project has broken reporting into 9 categories on the project website (https://save-project.co.uk/reports-and-presentations/) for ease of navigation and to direct relevance. The categorisation used and an overview of SAVE reports are shown in Table 15 below.

Table 15: SAVE Reports

Category	SDRC report	Details
Literature Review	SDRC 1 – Review learning from other projects	Findings from other projects used to inform SAVE trial design
Customer Model	SDRC 2.1 – Create initial customer model	Initial design of SAVE customer model
	SDRC 2.2 – Revise customer model	Updated design of SAVE customer model to accommodate network model requirements
	SDRC 2.3 – Finalise customer model	Final version of customer model, analytical assumptions and build decisions
Customer Engagement	SDRC 3.1 – Create customer engagement plan	Customer engagement plan linked to project DPS
	SDRC 3.2 – Hold open days	Evidence and learning from the projects first 5 open days and planning for the final 4 open days
Create Network and Pricing Model	SDRC 4 – Create commercial energy efficiency measures	An overview of SAVE's initial pricing model and initial thinking on routes to market for DNO led price signals
	SDRC 7.1 – Create initial network model	Initial design of SAVE network model
	SDRC 7.2 – Revise Model	Updated design of SAVE network model to accommodate customer model requirements
	SDRC 7.3/8.5 – Finalise Model(s)	Evidence as to the completion of SAVE's Network and Pricing model as well as final functionality
Evidence Reports	SDRC 5 – Identify control and trial sample group	Sampling processes and rigour to ensure un-biased RCT design
	SDRC 6 – Install 80% of loop sensors	Evidence as to installation procedures and tracking
Network Investment Tool Reports	SDRC 8.5/8.6 – Customer, Network and Pricing Model Report	Looks at the operation of each model and how they interact to form SAVE's NIT
	SDRC 8.2 – Network investment tool key outcomes report	Looks at the output of the NIT and how a DNO may use these outputs

Table 15: SAVE Reports (cont.)

Category	SDRC report	Details
Final Trial Reports	SDRC 8.3 – LED trial report	Methodology, analysis, outcomes and (commercial) applicability of SAVE's LED lighting trials
	SDRC 8.4/8.7 – Data informed engagement and price signals trial report	Methodology, analysis, outcomes and (commercial) applicability of SAVE's data informed and price signal trials
	SDRC 8.8 – Community coaching trial report	Methodology, analysis, outcomes and applicability of SAVE's CEC trials
Project Progress Reports	Jun 2014, Dec 2014, Jun 2015, Dec 2015, Jun 2016, Dec 2016, Jun 2017, Jun 2018, Jun 2019	(Bi)-annual reporting on project progress, trials, lessons, risks, dissemination and finances.
BaU Support Report	Regulatory Report	Looks into the regulatory considerations for government and DNO's in rolling out SAVE interventions
	Operational Report	A review of existing industry and DNO specific policies and procedures and how these may be updated to accommodate the NIT
	Commercial (essential consumption) Report	Use of SAVE data and trial outputs to inform what future use of system charging may look like under a 'cores' based mechanism

11

REFERENCES AND APPENDICES

Contact Details and Data Access

Further information and data access can be obtained:

- Through www.save-project.co.uk
- By emailing: futurenetworks@sse.com
- By writing to: Future Networks, Inveralmond House, 200 Dunkeld Road, Perth, PH1 3AQ

The SAVE project has also deposited project data with the UK Data Archive (UKDA). The data will be made available under the 'safeguarded' category. Safeguarded data requires users to be registered with the UKDA and accept their End User Licence.

Material change information

The SAVE Project had two material changes accepted by Ofgem. These are outlined in Section 4.

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