Appendix 1- SAVE info-graphics

ACCELERATING THE ADOPTION OF LED LIGHTING IN HOUSEHOLDS

Running from 2017-2018 in 1,000 residential properties in the Solent region, this trial aimed to increase uptake of LED lighting and assess the impact on the network and on customers' bills.

TRIAL DESIGN

- Opt-out approach (in-person visits door-to-door)
- Installed by project staff
- Up to 10 bulbs per household available
- Free of charge

HOUSEHOLD UPTAKE **76%**

AVERAGE NUMBER OF BULBS REPLACED **7**

AVERAGE ANNUAL SAVING PER HOUSEHOLD: **90 kWh**

ANNUAL EFFECT SIZE ACROSS VARIOUS METRICS

Household	SAVE project	SSEN customers	UK households
£15.82	37 tonnes CO_2	28,000 cars	1 nuclear power station

- Cost of national LED rollout £1 billion max
- New nuclear plant £5 billion

VULNERABLE CUSTOMERS

TREATMENT EFFECT

5%

GREATER FOR VULNERABLE CUSTOMERS THAN FOR THE AVERAGE CUSTOMER

CONCLUSION: if deployed in adequate quantities, and offered free and installed, LED bulbs can effectively reduce peak network load, save customers money on bills and reduce carbon emissions.

SAVE
Solent Achieving Value from Efficiency

Scottish & Southern Electricity Networks

EFFECTIVE PEAK LOAD REDUCTION THROUGH RAPID ADOPTION OF HOUSEHOLD LED LIGHTING

Running from 2017-2018 in 1,000 residential properties in the Solent region, this trial aimed to increase uptake of LED lighting and test the impact of this on the network.

TRIAL DESIGN

Opt-out approach (in-person visits door-to-door)

Installed by project staff

Up to 10 bulbs per household available

Free of charge

HOUSEHOLD UPTAKE

76%

7

AVERAGE NUMBER OF BULBS REPLACED

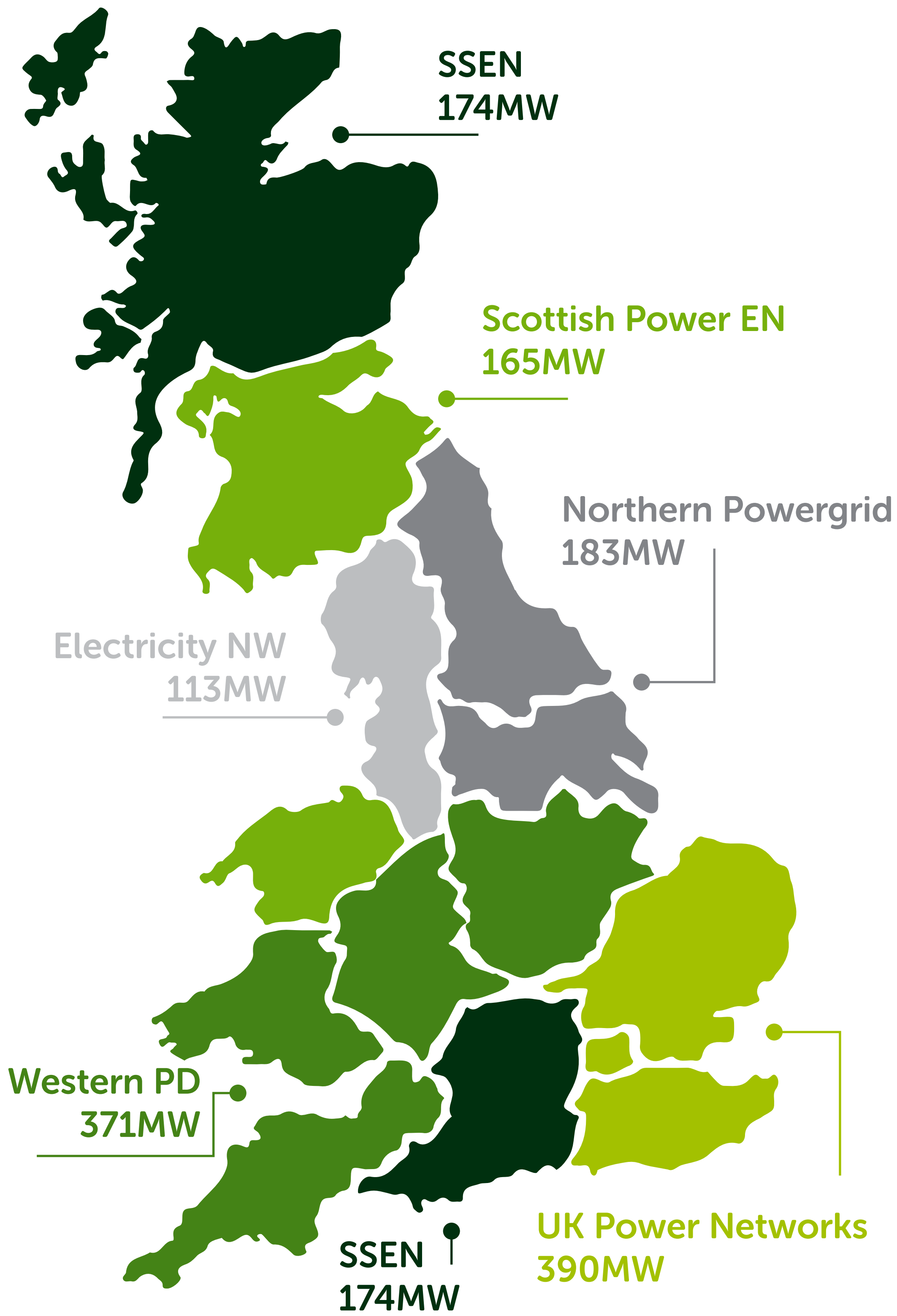
AVERAGE ANNUAL SAVING PER HOUSEHOLD:

90 kWh

EXTRAPOLATED LOAD REDUCTION

	Household	Primary substation	Grid supply point	UK households
PEAK	47 W	0.3 MW	8 MW	1,300 MW
ANNUAL	90 kWh	612 MWh	14,400 MWh	2.5M MWh

POTENTIAL PEAK LOAD REDUCTION



CONCLUSION: if deployed in adequate quantities, and offered free and installed, LED bulbs can effectively reduce peak network load, save customers money on bills and reduce carbon emissions.

SAVE Solent Achieving Value from Efficiency

Scottish & Southern Electricity Networks

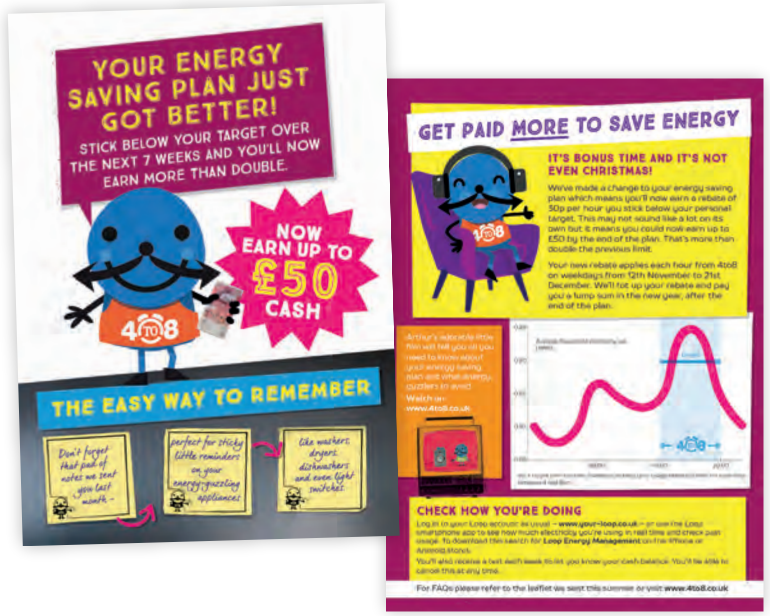
DYNAMIC PRICING INCENTIVES TO REDUCE PEAK ELECTRICITY CONSUMPTION IN HOUSEHOLDS

This trial with 2,000 residential properties in the Solent region aimed to test the effect of a variable tariff-style stimulus on peak consumption. As it was DNO led (and didn't involve a supplier) the programme was incentive only, paying participants a rebate for every peak hour they kept their consumption below a threshold. Participants were split with 1,000 being asked to opt in to the incentive, the other 1,000 being asked to opt out if they didn't want to take part.

TRIAL DESIGN

- Incentive 10p/ max £20
- Rising to 30p/ max £50
- Targets based on past energy consumption
- Households could track progress

BIGGEST REDUCTION IN CONSUMPTION SEEN IN THE WEEKS AFTER A MID-TRIAL POSTAL MAILER WAS SENT



KEY:

OPT IN

OPT OUT

PARTICIPATION RATE

- Opt in: 38%
- Opt out: 98%

MAX PEAK REDUCTION PER HOUSEHOLD, WHOLE GROUP

- Opt in: 17W
- Opt out: 44W

MAX PEAK REDUCTION PER HOUSEHOLD, PARTICIPANTS ONLY

- Opt in: 24W
- Opt out: 44W

AVERAGE TOTAL INCENTIVE PAY OUT, WHOLE GROUP

- Opt in: £13
- Opt out: £27

TREATMENT EFFECTS ACROSS TRIAL PERIOD

- Opt in: CONSISTENT
- Opt out: VARIABLE

REDUCTION WHEN INCENTIVE INCREASED, PARTICIPANTS ONLY

- Opt in: NO
- Opt out: YES

CONCLUSION: participants opting in to a dynamic pricing rebate scheme provide more consistent week-on-week reductions than those asked to opt out. However, an opt-out approach provided the greatest peak reduction both overall and in a single week. An opt-in approach is more cost effective on a per-customer basis, given lower opt-in rates, although this needs to be balanced with overall reduction aims.

SAVE
Solent Achieving Value from Efficiency

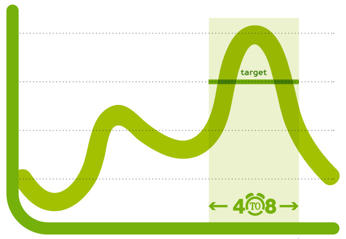
Scottish & Southern Electricity Networks

DYNAMIC PRICING INCENTIVES TO REDUCE HOUSEHOLD PEAK LOAD

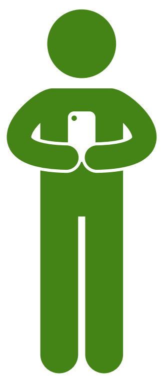
This trial with 2,000 residential properties in the Solent region aimed to test the effect of a variable tariff-style stimulus on peak consumption. As it was DNO led (and didn't involve a supplier) the programme was incentive only, paying participants a rebate for every peak hour they kept their consumption below a threshold. Participants were split with 1,000 being asked to opt in to the incentive, the other 1,000 being asked to opt out if they didn't want to take part.

TRIAL DESIGN

10p/max £20, rising to 30p/max £50



Targets based on past energy consumption

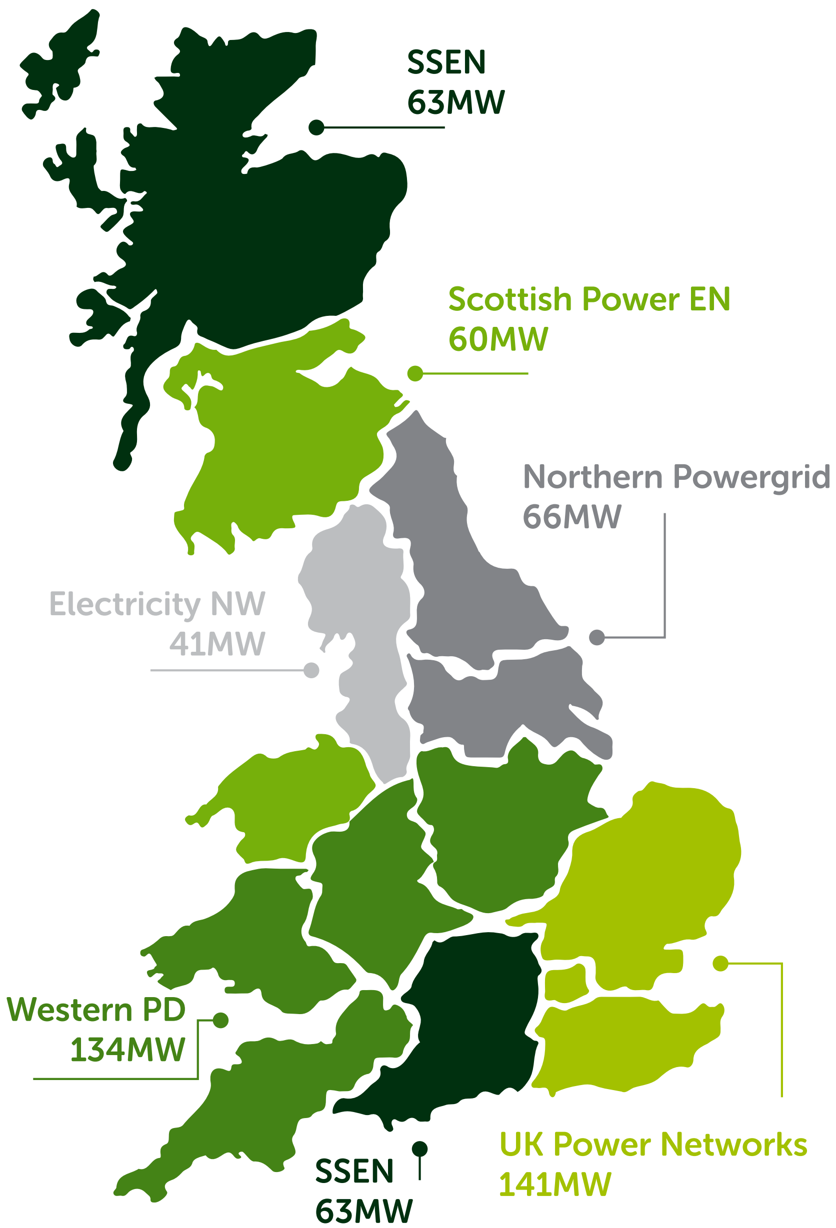


Households could track progress

OPT IN

PARTICIPATION RATE	MAX PEAK REDUCTION PER HOUSEHOLD	UK-WIDE POTENTIAL PEAK REDUCTION
38%	17W	653MW

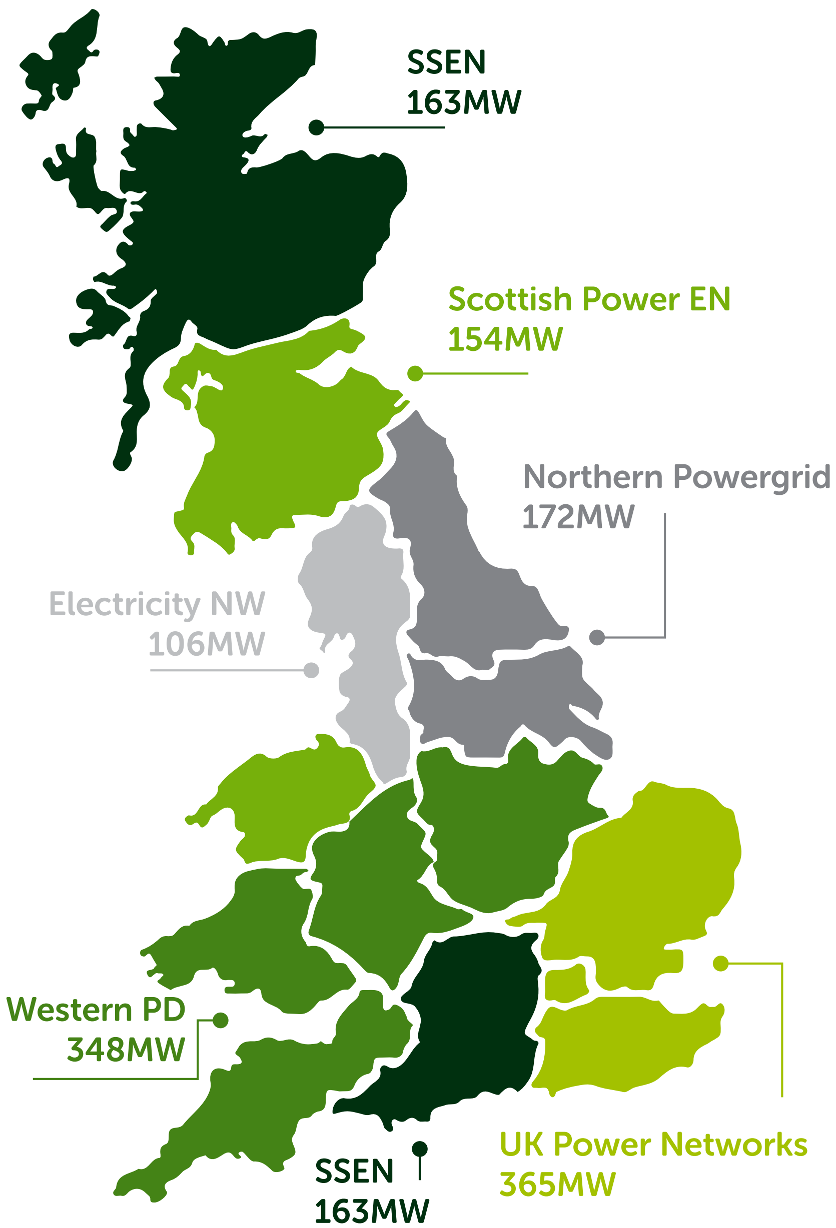
POTENTIAL PEAK LOAD REDUCTION



OPT OUT

PARTICIPATION RATE	MAX PEAK REDUCTION PER HOUSEHOLD	UK-WIDE POTENTIAL PEAK REDUCTION
98%	44W	1,197MW

POTENTIAL PEAK LOAD REDUCTION



CONCLUSION: participants opting in to a dynamic pricing rebate scheme provide more consistent week-on-week reductions than those asked to opt out. However, an opt-out approach provided the greatest peak reduction both overall and in a single week. An opt-in approach is more cost effective on a per-customer basis, given lower opt-in rates, although this needs to be balanced with overall reduction aims.

SAVE
Solent Achieving Value from Efficiency

Scottish & Southern Electricity Networks

USING SHORT TERM ASKS TO REDUCE PEAK ELECTRICITY CONSUMPTION IN HOUSEHOLDS

This trial with 2,000 residential properties in the Solent region aimed to test the effect of short term 'events' – asks of customers to reduce their consumption during peak hours. A variety of engagement methods were tested, from single day network events to week-long challenges, as well as additional financial incentives.

TYPES OF EVENT

- Network high load
- Adverse weather
- Partnership (energy saving trust)
- Appliance-specific
- One day target 20%
- Week-long challenge

CHANNELS

- Postal *
- Email
- Text
- Online portal

PEAK REDUCTION OF MOST EFFECTIVE EVENT (7%)

- Household → 35 W
- UK-wide potential → 952 MW

INCENTIVE

- £10 shopping voucher to all successful
- £10 coffee chain gift card to all successful *
- £100 restaurant gift card, prize draw of 20
- £1,000 supermarket gift card, prize draw of 1

The use of incentives led to a small additional impact but not significant enough to warrant the additional cost

TIME LENGTH

- 2 hour peak *
- 4 hour peak
- 2 days peak
- 1 week peak

* MOST EFFECTIVE ENGAGEMENT ELEMENTS

CONCLUSION: whilst many of the event based engagement methods led to small reductions under 5%, some were more successful. Notable learnings include: prompting customers appears to be effective in reminding them about the 'ask'; ongoing engagement is helpful, although messaging fatigue can occur with too much contact; postal communications are most effective in terms (higher reach and engagement); partnering with trusted organisations appears to help land an 'ask'; additional financial incentives on average proved no more effective. Events seem to work best when part of a longer term engagement programme, rather than as one-offs.

SAVE – Solent Achieving Value from Efficiency

Scottish & Southern Electricity Networks

SAVE (SOLENT ACHIEVING VALUE FROM EFFICIENCY): RESULTS HIGHLIGHTS

The SAVE project set out to robustly trial and establish to what extent energy efficiency measures can be considered as a cost effective, predictable and sustainable tool for managing peak demand as an alternative to network reinforcement. The project targeted domestic customers only and measures trialled included deploying technology (in the form of an LED bulb rollout), offering price incentives and taking innovative approaches to customer engagement.

The project was based in the Solent region, which is representative of much of the UK in terms of demand. Four matched groups of households participated as a randomised control trial (RCT), a total of 4,000 homes with one group acting as a control.

In addition, the project has developed a Network Investment Tool, designed as a forward-looking tool, with a Distribution System Operator (DSO) in mind. This provides the means to assess and select a cost-efficient methodology for managing electricity distribution network constraints.

ACCELERATING THE ADOPTION OF LED LIGHTING IN HOUSEHOLDS

HOUSEHOLD UPTAKE 76%

AVERAGE NUMBER OF BULBS REPLACED 7

AVERAGE ANNUAL SAVING PER HOUSEHOLD 90 kWh

ANNUAL EFFECT SIZE ACROSS VARIOUS METRICS

Household	SAVE project	SSEN customers	UK households
£15.82	37 tonnes CO_2	28,000 cars	1 nuclear power station

KEY LESSONS FROM COMMUNITY ENERGY COACHING

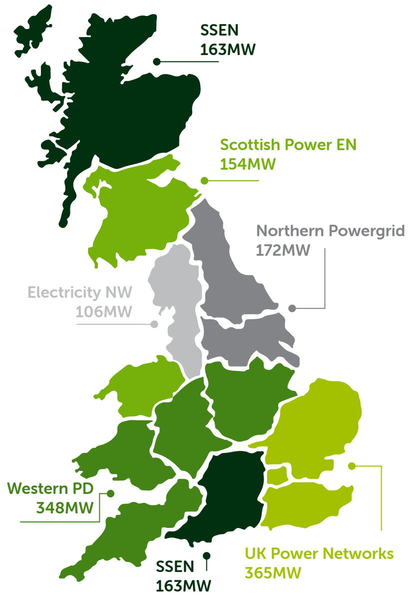
- Win/win approach based on direct local collaboration
- Created trusted intermediaries and local brands
- Expanded individuals' energy literacy
- Added value benefits for stakeholders incl. councils and other utilities

Shirley Warren Working Together

TIME OF USE PRICE INCENTIVES TO REDUCE PEAK ELECTRICITY CONSUMPTION IN HOUSEHOLDS

BIGGEST REDUCTION IN CONSUMPTION SEEN IN THE WEEKS AFTER A MID-TRIAL POSTAL MAILER WAS SENT

POTENTIAL PEAK LOAD REDUCTION – WITH AN OPT-OUT RATE OF 2% EMBEDDED



USING SHORT TERM ASKS TO REDUCE PEAK ELECTRICITY CONSUMPTION IN HOUSEHOLDS

MAX PEAK REDUCTION (7%)

Household → 35 W

UK-wide potential → 952 MW

MOST EFFECTIVE ENGAGEMENT ELEMENTS

Channel: postal

Time length: 2hr peak window — 5-7 PM

Incentive: coffee chain gift card to all successful — £10

NETWORK INVESTMENT TOOL STRUCTURE

- **Customer Model (UoS)**
  - Customer types
  - Load profiles
- **Network Model (EA Tech)**
  - Load growth scenarios
  - Capacity interventions
- **Pricing Model (EA Tech)**
  - Traditional solutions
  - EE-based solutions

Limitations and risks

BAU

Network Investment Tool (SSEN)

Appendix 1.1.2- Behavioural Engagement Letters

Throughout the SAVE project, communication with participants loops devices were an ongoing focus to maintain communications. As reported in SAVE's June 2017 12 monthly report, roughly three quarters of these issues were down to customers unplugging loop devices and hence could be solved very simply by customers (field visits were a very expensive way to fix such behavioural issues). Throughout the project these were resolved through 3328 letters. 1012 of these letters were to be targeted at 'dis-engaged' users. As a result, to try and maximise response rates to the letters the project team used to engage participants a series of behavioural 'nudge' techniques were deployed. The engagement trial included split households randomly into three groups, a control group (receiving a basic engagement letter), a 'norms' group (see below) and a reciprocity group (see below).

Norms

SAVE's 'norms' letter used a philosophy of suggesting to participants that by having an unplugged loop they were in a minority. Research shows that people like to be in the majority and it is possible to exert pressure on them to change their behaviour if they find that they are in a minority. This kind of messaging is proven to be most effective if it is specific

This technique has been tested and proved successful throughout behavioural psychology and perhaps most famously by the UK tax department who increased response rates to letters from HMRC by 5% by applying behavioural norming techniques (Halpern, 2015).

Reciprocity

SAVE's 'reciprocity' letter understands peoples desire to be consistent with their commitments and promises. Reciprocity is the principle charities use when they include a small gift when trying to solicit donations. On SAVE people are aware that they are part of a long-term programme which clearly involves a lot of investment and effort (and which they have been incentivised to participate in), the reciprocity letter looked to activate this sense of obligation and ask them to stick to their side of the bargain.

Results

Of the 1012 (334-340 per group) households engaged response rates showed:

A baseline engagement rate of: 12.6% (43/340 customers)

For the 'norms' message an engagement rate of: 11.8% (40/338 customers)

For the 'reciprocity' message an engagement rate of: 16.5% (55/334 customers)

Norms would appear to have no additional impact on response rate, perhaps because the norm used was too low to customers feel in a 'minority' or customers already assumed a high participation rate.

Reciprocity, however appeared to boost responses by around 4%. If scaled across SSEN’s 3.7 million this extra 4% could increase response to similar mailers by 148,000 customers.

An example of each letter is given below showing: Control, Norms and Reciprocity respectively.

IT'S EASY TO GET YOUR ENERGY MONITOR WORKING AGAIN

«address»
«town»
«county_»
«postcode»
«EXTRA»

Study ID: «bmg_id»

3 July 2019

Dear «title» «Firstname» «Surname»,

Your energy monitor has been disconnected.

Something's happened to your Loop energy monitoring kit and we have not been receiving data since «last_read». It only takes a moment to get it up and running again. Here are the easy steps we need you to follow.

Step 1: Please check that the power supply plug is correctly plugged into the wall and the USB cable from the blue Loop Receiver is connected to the plug. Also check that the blue ethernet cable is connected from your Loop receiver to your internet router or hub.

- If all the connections are correct, you should see a steady continuous green light on the back of the blue Loop Receiver.
- If you see a flashing green light or anything else, go to Step 2.

Step 2: Turn your internet router or hub OFF, leave for ten seconds then turn it back ON again

Step 3: Remove the blue Loop Receiver ethernet cable from your router or hub and then reinsert it

Step 4: Remove the USB cable from the power supply plug and then reinsert it

Usually these steps will re-establish the connection and the blue Loop Receiver will show a steady continuous green light on the back.

If your Loop is still not connecting and you require further support, please call the Loop Support Team on **01394 385363** (local rate) or email us at **contactus@your-loop.com**

This study is being conducted in accordance with the Data Protection Act. This means your personal details will be kept strictly confidential and you and your household will not be identifiable from the data.

Thank you for taking the time to get your energy monitor back up and running and for your ongoing participation in the SAVE research project. Your commitment to the project is enabling us at the University of Southampton to gather a unique and important picture of how energy is used within our homes. Projects like SAVE are crucial to developing a smarter, more sustainable and reliable electricity network for the future.

For more project related information please visit: http://www.energy.soton.ac.uk/save-solent-achieving-value-from-efficiency/

Yours sincerely,

p.p. Professor AbuBakr Bahaj
Head of Division, Energy & Climate Change, University of Southampton

This study is being conducted in accordance with the Data Protection Act. This means your personal details will be kept strictly confidential and you and your household will not be identifiable from the data.

MORE THAN 70% OF PEOPLE ARE PLUGGED IN

«address»
«town»
«county_»
«postcode»
«EXTRA»

Study ID: «bmg_id»
3 July 2019

Dear «title» «Firstname» «Surname»,

Join thousands of others and get your energy monitor up and running again.

We have not been receiving data from your Loop energy monitoring kit since «last_read» and we want you to join everyone else back on our energy saving research study. Here are the easy steps we need you to follow.

Step 1: Please check that the power supply plug is correctly plugged into the wall and the USB cable from the blue Loop Receiver is connected to the plug. Also check that the blue ethernet cable is connected from your Loop receiver to your internet router or hub.

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Head of Division, Energy & Climate Change, University of Southampton

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PLEASE PLAY YOUR PART
IN MAKING THE 'SAVE' PROJECT A SUCCESS

«address»
«town»
«county_»
«postcode»
«EXTRA»

Study ID: «bmg_id»
3 July 2019

Dear «title» «Firstname» «Surname»,

Your involvement is essential to our energy saving research.

You've been an important member of our energy saving research study since you signed up. However, we have not been receiving data from your Loop energy monitoring kit since «last_read». Please play your part in getting it back up and running again. Here are the easy steps we need you to follow.

Step 1: Please check that the power supply plug is correctly plugged into the wall and the USB cable from the blue Loop Receiver is connected to the plug. Also check that the blue ethernet cable is connected from your Loop receiver to your internet router or hub.

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Thank you for playing your part and getting your energy monitor back up and running and for your ongoing participation in the SAVE research project. Your commitment to the project is enabling us at the University of Southampton to gather a unique and important picture of how energy is used within our homes. Projects like SAVE are crucial to developing a smarter, more sustainable and reliable electricity network for the future.

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The following pages sequentially show summer newsletters sent to each SAVE project participant across 2017, 2018 and 2019

SAVE Newsletter Summer 2017

A BIG thank you!

Firstly, a big thank you for your continuing participation in the 'SAVE' research project. Your data is helping us to provide valuable new insights into how, and when, we use energy in our homes. By taking part you are directly helping to make the UK a more energy efficient place to live.

Why is the SAVE project important?

As a society we need to find new ways to better manage our overall energy consumption. We also need to try to shift electricity consumption from evening 'peak' periods when the network can become overloaded, especially in winter. To help do that the SAVE project is carrying out ground-breaking research on how and when households use electricity in the Solent region.

This research is so novel that our early results are already feeding directly in to UK Government plans for a smarter, more efficient electricity network.

Your electricity use

As you may already know, much like yourself, each household participating in this research has a Loop Energy Saver kit which collects information on your household's electricity consumption.

This data is critical to the project, so please keep it switched on and connected, thank you. ☺

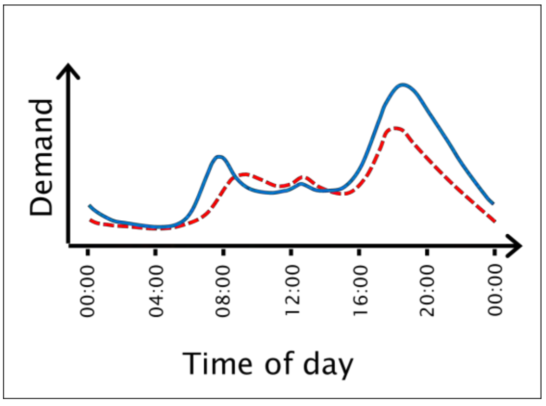
If you think your kit is not working properly, or have any concerns about it, please contact . XX Navetas or BMG? XX .

Why you matter!

To be able to say something meaningful about the electricity data we are collecting we need the projects 4,000 trial households to reflect the population of the Solent region. This means it is really important that you stay in the project and provide our researchers with some information about your household. This will let us answer questions such as:

- Which kinds of households uses most electricity, when?
- What activities is it used for?
- How does use change over time?

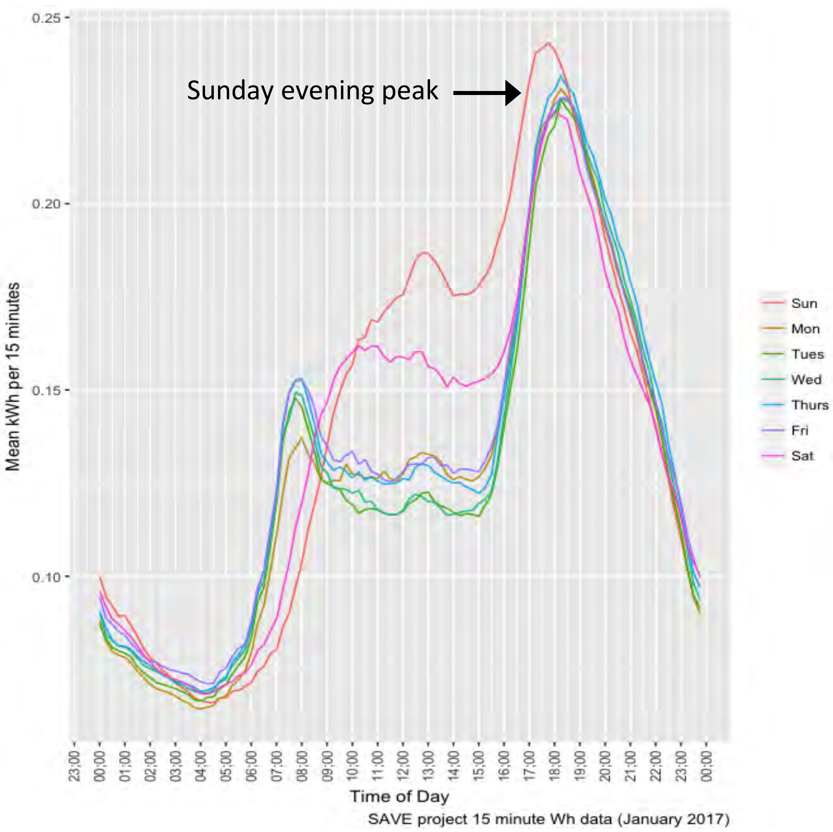
By asking questions about your household, we can find out if different households use energy in different ways, and at different times.



For example, this chart illustrates the different electricity demand profiles for households where the response person is working (blue line) and retired (red, dashed line).

Without information about your household, which is anonymised and held securely by the University of Southampton, we cannot make sense of the Loop Energy Saver data. Most of our participants have already completed an initial survey about their household, if you are yet to do so, please respond to the survey requests from our fieldwork contractor BMG (contact etc . . .)

SAVE data is already providing new insights



The data collected by the 'SAVE' project over the 2016/17 winter is already being put to good use.

For example, analysis by the University of Southampton has revealed a previously unidentified peak in household electricity demand on Sunday evenings. This finding goes against the widely-held assumption that household peak demand occurs during the working week and has already been discussed in meetings with energy regulators, Ofgem.

Such findings are very valuable to electricity network planners, whose job it is to ensure the power system- operates in the most sustainable, reliable and cost-effective manor for consumers.

What next?

As we progress with the project, your support is critical. Please help us continue making an impact by participating in our surveys. You will earn vouchers by completing them.

You can view the energy data we are collecting through the Loop website or using the Loop app on your smartphone - search for 'Loop Energy' in Apple App Store or Google Play.

Sentence on data security and anonymisation.

<Address 1>
<Address 2>
<Address 3>
<Town>
<County>
<Postcode>

Study ID: <9566XXXXX>
May 2018

SAVE Project Annual Newsletter

You're shaping a greener future!

Three years on from the install of our first electricity monitors the SAVE project is now approaching its final year of operation. Without even reporting its final learning the project is already influencing electricity markets across the UK, amazing academics and even feeding into government decision making. It is a credit to your continued participation on SAVE which is allowing this learning to deliver smarter, more sustainable and more reliable energy markets in years to come.

It is with sincere thanks that the whole project team writes this update to you. By taking part in SAVE you are directly helping to make the UK a more energy efficient place to live.

Why you're crucial to SAVE's success

SAVE is a ground-breaking research project, exclusive to residents of the Solent area and in partnership with the University of Southampton to better understand how people use their energy and hence how the UK should build its energy strategy. By providing consumption data, alongside the surveys the project asks, we are able to create models showing where increases in electricity (through electrification of vehicles, heating and other gadgets) could cause challenges to the electricity network as well as how we might manage such issues in the most sustainable and cost-effective means.

For you this can mean a less carbon intensive and less expensive future. As additional small thanks for your participation the project will be issuing £5 vouchers for those participants who stay with us until February 2019, this amount could further be boosted by participating in our project surveys.

UNIVERSITY OF Southampton

SAVE Solent Achieving Value from Efficiency

bmg research

The data we collect from the Loop kits in your home (pictured below) is critical to the project, so please keep it switched on and connected, thank you. ☺ If you think your kit is not working properly, or have any concerns about it, please call **the Loop Support Team on 01394 385363 (local rate) or email to <u>contactus@your-loop.com.</u>**

You can view the energy data we are collecting through the Loop website or using the Loop app on your smartphone - search for ‘Loop Energy’ in Apple App Store or Google Play.

What next?

The project is randomly dividing individuals into groups for a final set of trials. Some of these groups will receive further material over the next 6 months, others may receive none. We cannot let any individual know their grouping until post project but we will be in touch in early 2019 to update you on our findings, send your final thank you voucher and provide insight into project closedown. Thank you again for keeping your electricity monitors ticking over and should you have any questions please feel free to get back to us at: save@sse.com

All the best,

Charlie Edwards   Bakr Bahaj   Elizabeth Steele   Stacey Hughes

The Loop Support Team

And the whole project team!

One Last Note…

Two years ago, the project team issued a note asking to remove all smart plugs from appliances (pictured right) as a precautionary safety measure. Investigations found these plugs may be incompatible with certain appliances. Field work at the time looked to removed these devices, however should any smart plugs remain in situ please unplug them and contact save@sse.com. We will send a pre-paid return parcel to dispose of the item. Please do not confuse this with the Navetas Loop (pictured at the top of the page) which is operating normally and as expected. Should you have any difficulties contact the project on save@sse.com or call 0800 358 0337 (9am – 5pm, Monday - Friday).

UNIVERSITY OF Southampton NEIGHBOURHOOD ECONOMICS

SAVE

Solent Achieving Value from Efficiency

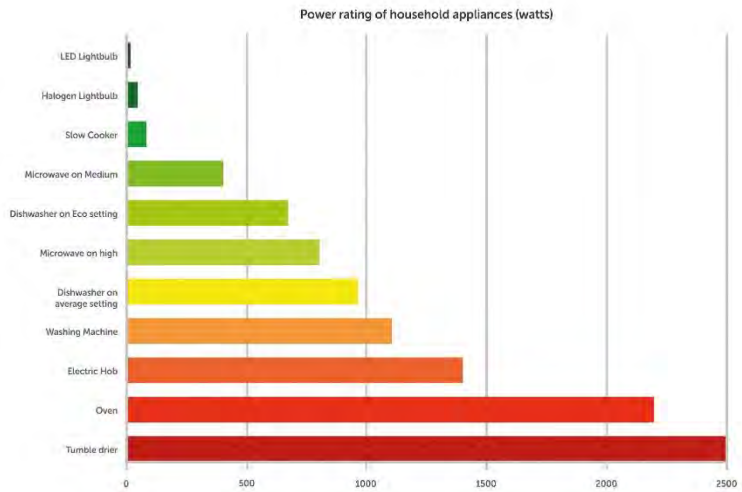
bmg research DNV·GL

Respondent name
Address 1
Address 2
Town
Postcode

June 2019
BMG ID:<<xxxxxxxxxxx>

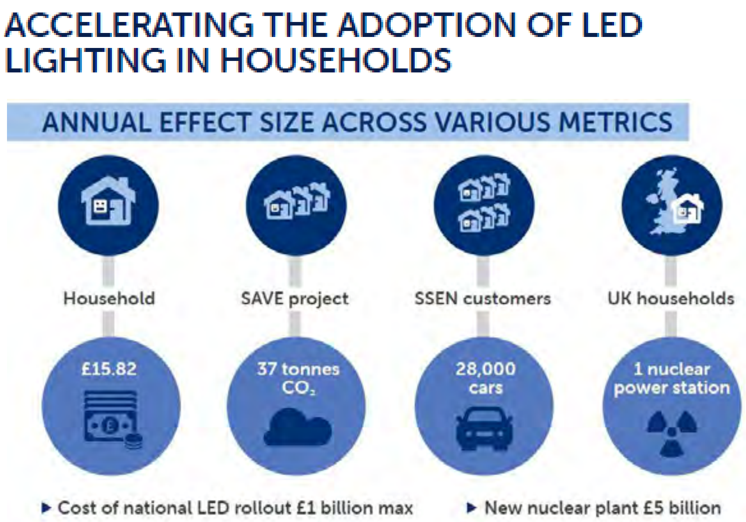
Dear <<Respondent name>>

We would like to thank you for your participation in the 'SAVE' research project. Your participation helped us to provide valuable new insights into how, and when, we use energy in our homes. By taking part you directly helped to make the UK a more energy efficient place to live.



Thanks to your participation SAVE has already saved over 135 MWh of energy or the equivalent of 67 thousand loads of washing thanks to its trials.

And this is only the start! Thanks to the learning you have supported SSEN will be able to continue to rollout smarter energy strategies leading to a greener and more cost-effective electricity network for us all!



See how the trials you participated in played a role in the wider SAVE project. As well as precisely how your support has been built into real world energy savings through our new SAVE website.

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NEIGHBOURHOOD ECONOMICS

SAVE

Solent Achieving Value from Efficiency

bmg research

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CERTIFICATE

of PARTICIPATION

This certificate is awarded to:

<<Respondent name>>

For successfully participating in SAVE project held in Solent in 2014-2019.

<<DD/MM/YYY>>

Date

Signature

Scottish & Southern Electricity Networks

Appendix 1.4.1
Background Review of Good Practice in Community Engagement

August 2014

Document Ownership

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SAVE

Solent Achieving Value from Efficiency

Scottish and Southern Energy Power Distribution

NEIGHBOURHOOD ECONOMICS

energyinnovationcentre ...ideas into reality

COMMUNITY COACHING TRIAL

Background Review of Good Practice in Community Engagement

August 2014

CONTENTS

This Review has been undertaken by Neighbourhood Economics Ltd in association with Praxis Evaluation and Research CIC

1 The SAVE Project

The SAVE (Solent Achieving Value from Efficiency) project is a Low Carbon Network Fund (LCNF) project which is being led by Scottish & Southern Energy Power Distribution (SSEPD). It aims to trial and establish to what extent energy efficiency measures can be considered as a cost effective, predictable and sustainable tool for managing peak demand as an alternative to network reinforcement. The project will target domestic customers only, and the measures to be trialled will include deploying a technology, offering a commercial incentive and taking an innovative approach to engagement.

The SAVE Project Team includes SSEPD, DNV-GL, Maingate Systems, University of Southampton, Future Solent and Neighbourhood Economics Ltd (NEL).

The SAVE project will be based in the Solent and surrounding area in the South of England, which is representative of much of the UK and where the Local Authorities are already creating challenges for the network as a result of implementing a strategy of supporting and encouraging local communities and businesses to develop opportunities and growth.

On completion of the project other Distribution Network Operators (DNOs) will have a suite of tools to assess a particular network's suitability for demand reduction through energy efficiency measures and allow informed investment choices to be made between using customer engagement and energy efficiency measures as opposed to traditional technology based measures and "smart" solutions.

The duration of the overall project is 54 months, commencing January 2014.

1.1 The Trials

The formal trials, which will take place between January 2016 and December 2018, will consist of evaluating 4 energy efficiency measures on participants in the Solent region. The methods have been chosen to allow an assessment of multiple factors, such as cost and effort required to install/implement. The 4 trial methods are:

1. LED installation
2. Data-informed engagement campaign
3. DNO price signals direct to customers plus data-informed engagement
4. Community coaching

Methods 1-3 will each have a sample group of up to 1,000 customers, with up to a further 1,000 making up a control group for comparison. Trial 4 will focus upon 2 separate local communities of up to 1000 properties each.

1.2 Project Aims

The Project aims to produce a network investment decision tool that will allow DNOs to assess and select the most cost efficient methodology for managing a network constraint.

The aim will be achieved through the following objectives:

- Create hypotheses of anticipated effect of energy efficiency measures (via commercial, technical and engagement methods)
- Monitor effect of energy efficiency measures on consumption across range of customers
- Analyse effect and attempt to improve in second iteration
- Evaluate cost efficiency of each measure
- Produce customer model revealing customer receptiveness to measures
- Produce network model revealing modelled network impact from measures
- Produce a network investment tool for DNOs
- Produce recommendations for regulatory and incentives model that DNOs may adopt via RIIO

1.3 Intended Learning Outcomes

The learning objectives for the trials conducted in the project are:

- to gain insight into the drivers of energy efficient behaviour for specific types of customers
- to identify the most effective channels to engage with different types of customers
- to gauge the effectiveness of different measures in eliciting energy efficient behaviour with customers
- to determine the merits of DNOs interacting with customers on energy efficiency measures as opposed to suppliers or other parties.

2 The Coaching Trial

2.1 Principles and hypothesis

Trial method 4 represents an alternative approach to engagement. It will be led by Neighbourhood Economics Ltd (NEL). Within the SAVE Programme, the coaching trial will seek specifically to:

- ***'embed'*** a community energy coach within an agreed target community providing a dedicated and consistent local presence

- work with all local stakeholders and partners to ***'build'*** the capacity to embrace change in energy consumption; and

- draw on the support of all stakeholders and partners in mobilising and integrating grassroots effort to cultivate enterprise opportunities which will generate income to ***'sustain'*** and further develop the positive behaviour change which the programme has served to trigger.

The Community Energy Coach will be embedded within the area, working from within a local host organisation to facilitate change and empower each community to deliver and sustain its own demand reduction. Host organisation(s) will be resourced and supported accordingly.

As distinct from the 3 other trials, there will be no recording of data linked to individual customers in the Coaching trial. Instead 'cordon area' monitoring will take place at substation level. Results in terms of overall reductions in area-wide usage will be assessed and compared through the network modelling. Based on advance profiling, NEL will identify and select 2 differentiated communities of up to 1000 properties in each, potentially:

- one relatively affluent and aspirational, being seen as an attractive place to live with a relatively high quality of life allowing greater local engagement in choices regarding sustainability; and

- one relatively disadvantaged and increasingly susceptible to adverse effects in the local economy, many within the community being disaffected and potentially harder-to-engage on sustainability issues. Although hard-to-engage they have the potential to have a significant impact for customers as small energy changes have a bigger impact if the customers have less disposable income and are in fuel poverty.

As with the other trials, there will be control groups, in this case made up of comparable neighbourhoods likewise of up to 1,000 properties each. Substations in the control areas will also be monitored for direct comparison to the active trial community areas.

The formal trials will commence in January 2016 but it is anticipated that the trial communities and control areas will have been identified by end of December 2014 in order to allow for the installation of substation monitoring equipment and the gathering of baseline data.

Building upon the 'embed, build, sustain' principles, the following hypothesis will be formally tested as part of the proposed research trial:

> *"Measurable changes in localised consumption behaviours generally – and in terms of peak energy demand reduction in particular – are more likely to be achieved with key local and national stakeholders working intensively together to resource and empower defined geographical communities in actively embracing a compelling, locally relevant, collaborative sustainability-related theme. Furthermore, resultant positive behaviour change is more likely to be reinforced and sustained in the long-term by the momentum of pooled stakeholder effort".*

2.2 Community Coaching as a Model

This is a relatively new concept originating from the USA that has been defined as: 'an adaptive process tailored to unique community contexts to guide systematic change via participant empowerment.' In a UK context this aligns it closely with a community development approach, which is further suggested in the description of what a community coach does: "A coach works with a community over the long term building the capacity to: improve communication, resolve conflicts, strengthen relationships, identify and connect to internal and external resources, provide opportunities for individual and collective learning, and respond to change."[10]

Three elements have been identified as being critical in preparing to use coaches in community change initiatives: commitment to a common vision, commitment to a learning culture and commitment to clear rules of engagement.[11] One factor that distinguishes community coaching from other forms of community engagement is that the coach may bring specific technical skills and knowledge to the table. This is consistent with the approach being adopted in the SAVE community coaching trial that combines knowledge about energy efficiency with a community development approach to engaging and working with the target communities.

3 This Review

3.1 Context

Against this background, this review as undertaken by NEL (in association with Praxis Evaluation and Research), aims to inform the development of the SAVE Community Coaching Trial. It focuses on the evidence of 'good practice' and learning that can be drawn from research and evaluation studies concerned with the effectiveness of community engagement as a means of achieving desired policy outcomes. In particular it reviews community engagement in respect of recent (circa last ten years) UK regeneration programmes and energy saving and related initiatives. Brief consideration is also given as to what social or behavioural theory has to say about community engagement that is of relevance.

This review complements the earlier (June 2014) DNV-GL review of customer behaviour change undertaken for the SAVE project[12] and focuses distinctively upon broader community engagement approaches associated with behaviour change. It culminates in a summary of the key messages which should underpin community engagement work to be undertaken as part of the Coaching trial.

As such, it is anticipated that specific good practice lessons may be further examined with a view to incorporation into the operational manual for the coaching trial to be co-produced with community-based partner organisations and other key stakeholders once the trial areas have been selected. As a key part of this further examination, partners and stakeholders working through the formal Stakeholder Group for the Coaching trial, will draw upon the key lessons from both this and the associated DNV-GL report in reviewing potential interventions to be delivered as part of the trial within the broad 6Es / MINDSPACE Framework[1].

[1] As elaborated in the DNV-GL review (Section 2, nb 2.2.3)

3.2 Consistent Learning

Particular points or issues where messages from this and the separate DNV-GL review suggest some ambivalence or divergence of evidence, are identified as footnotes throughout the text.

4 Defining terms

4.1 Community

The term community has become a prefix to a wide range of interventions, policies and practices in the UK that dilutes it of any clear meaning. In part this reflects its elusiveness as a social construct and the different definitions applied to it by sociologists. It also evidences a lack of clarity or consistency in its use within a policy context. On occasion the word community appears to be used simply to imbue or illicit some form of positive endorsement, without careful consideration of what it implies or how it is understood by the individuals and communities concerned.

Walker (2011) suggests community is regularly used to popularise and badge policy initiatives such as low carbon communities. Five different but interconnected meanings in the use of community within environmental and carbon-related policy initiatives are identified by Walker:

- Community as actor; the community as having agency to act and interact with others and frequently is meant as a category of the ‘the public’.
- Community as scale, within a hierarchy that places community above family, but below the level of local government.
- Community as place, usually also implying a set of social relationships embedded within a particular locality.
- Community as network, which can include social relationships that are not bound by a specific locality.
- Community as process, being a distinctive way of acting and involving the participation of ‘ordinary people’ in collaborative actions.

An evaluation of community-based localism in UK renewable energy policy (Gordon et al, 2007) identifies the flexible and divergent ways community was defined by interviewees involved in a range of renewable energy programmes. Some of the projects evaluated evidenced extensive local participation and ownership, while in others it was difficult to discern any substantial local involvement. It was not possible to assume that all the ‘community projects’ exhibited, ‘characteristics of collective community leadership, management or ownership, or substantial embedded benefits for local people…’ The extent of malleability in the use of community could have negative consequences, with tensions evident between the different actors involved as to what it should mean.

A pragmatic approach to selecting the communities that will participate in the Community Coaching Trial has been adopted based on a range of criteria including demographics, spatial characteristics and income profile. An examination of the concept of community points to the complexity and multi-faceted nature of the social networks and interactions that will be found within any selected area. This in turn indicates the challenge that will exist in making comparison between areas and the difficult of selecting 'control' neighbourhoods.

The need to know the community you are working within is a consistent message from evaluation studies of community engagement within area based initiatives. This should not be regarded as simple or a process that can be speedily accomplished.

4.2 Community Engagement

The terms community engagement, community involvement and community development are often used interchangeably with loose, multiple and sometimes conflicting definitions. This can reflect differences between the agencies defining the terms and the context in which they are used. The National Institute for Health Clinical Excellence[13] refers to community engagement as 'the process of getting communities involved in the decisions that affect them'. Haringey Council[14] also sees it as a process, but one that involves 'informing, listening, consulting, involving, collaborating and empowering'. The Metropolitan Police[15] describes community involvement as 'the proactive harnessing of the energies, knowledge and skills of communities and partners not merely to identify problems but also to negotiate priorities for action and shape and deliver solutions'.

The Community Development Exchange[16] suggested that community engagement and similar terms such as community involvement and community participation usually refer to attempts to encourage communities to get involved in the work of an outside agency or organisation. This is more likely to start with the needs or targets of the agency, rather than the needs of the community. In contrast community development has been defined as a process that enables people to organise and work together to, 'identify their own needs and aspirations, take action to exert influence on the decisions which affect their lives, improve the quality of their own lives, the communities in which they live, and the societies of which they are a part.'[17]

It is suggested that community development should not be seen as a term to cover everything and anything that agencies do with their customers, or a cheap way of delivering services or of consulting on decisions already made. It is a long-term process with a focus on addressing people's needs through sustainable change and involving working in partnership with the community. A community development approach to community engagement moves beyond residents being relatively passive consultees to being active participants able to meaningfully influence process and outcomes.

5 Community engagement in regeneration programmes

Studies of regeneration initiatives illustrate the difficulty of capturing robust evidence as to the effect of community engagement on both behaviour and programme outcomes. The lack of clarity in respect of the terminology used in talking about community engagement tends to be reinforced in reviewing programme evaluations. These largely provide qualitative evidence about impact and good practice rather than developing quantifiable measures as to the effectiveness of community engagement.

A systematic review of research evidence in respect of community involvement in area based initiatives targeting areas of social or economic disadvantage was commissioned by the Home Office (Burton et al, 2005). This noted the lack of specificity in the methodologies employed in determining 'what works'. Many of the studies reviewed concluded that community involvement could have been better planned, with more consideration given in advance to roles, processes, methods and resources. Clarity was required about the nature of the intended community involvement and the role the community would play. The need for flexibility was stressed along with a preparedness to change goals in the light of community involvement. Representative structures had to have legitimacy in the eyes of local people, to be transparent and to allow for increasing community participation.

Complex formal representative structures could be counter-productive in not providing a means of capturing the enthusiasm and commitment of local residents. A distinction could be made between representation at a strategic level which often relied on proxy representation e.g. a community development worker at a grassroots level where local people were more likely to be involved. It was necessary to ensure good links between these different levels of involvement.

Some studies suggested that public sector partners in particular failed to understand the processes and consequences of a community development approach. Several other studies highlighted the importance of recognising the process of community involvement and what it entailed.

A strong community voice that held agencies to account was not always welcomed. At the same time some officials had expectations of higher levels of representativeness and accountability from community representatives than from other partners. A concern about community representation being confined to 'the usual suspects', had to be balanced with the problem of turnover and the 'loss of community memory and experience.'

Being clear about what constitutes the local community and being as inclusive as possible was important. The local context had to be taken account of including the previous history and patterns of involvement and community diversity. Consideration also had to be given to the suitability of existing community organisations in helping facilitate community involvement.

There was wide agreement on the need to provide resources to support and sustain community involvement, though little said about what adequate levels of these would be. This could include a budget for community development, training and capacity building as well as for covering travelling and other expenses incurred by community representatives.

For professionals engaging with communities in area based initiatives a number of changes in working practice were identified, including:

- Improving communication
- Clarity about roles and responsibilities
- Building trust amongst partners
- Acknowledging the importance of process as well as product
- Avoiding domination by powerful groups
- Accessible and transparent decision making structures; and
- Empowering, training, skills development and education for all stakeholders.

Among the things to avoid was inconsistency in officer commitment, sometimes as a result of staff turnover, as well as duplicating other consultation activities. It was important to be clear about purpose and objectives and to build on existing structures of community representation. While residents appreciated being involved they wanted to see tangible outcomes from this. The perception that 'the agenda' had already been set and would not change as a result of community consultation or involvement unsurprisingly worked against community participation.

A review of the 'Working for Communities' programme (Brown, 2002) identified good practice in relation to community consultation and awareness raising. This included the need for careful planning, with time built in for consultation within the project and programme lead-in time. The use of skilled and experienced facilitators was important as was working with and through existing groups and providing the community with feedback. Again as part of the overall community engagement process, recognition was given as to the importance of providing opportunities for training and capacity building for community members. Joint training for residents, members and professionals could be particularly effective.

A 2006 evaluation of the engagement of communities in regeneration in Scotland[18]identified a number of barriers to effective community engagement including:

- Low levels of awareness and apathy within communities
- Lack of financial support and childcare
- Difficulties of engaging young people and 'hard to reach' groups
- Not providing opportunities for individuals and groups to be engaged at all levels of the process
- Difficulty in developing community confidence
- Disparities in how developed community engagement networks were between new regeneration areas and established target communities
- Red tape constraints
- Too many demands on the time of community representatives
- Little time invested in building partnership relationships
- Information overload and lack of information that was easy to understand and use of jargon
- Limited feedback on community involvement from projects and little feedback from the wider community
- Feedback not demonstrating changes or impacts

- Lack of time given to staff due to agencies not understanding the benefits of community engagement
- Lack of training in the Standards (Scottish) of community engagement

Partnerships instituted a variety of responses to address these barriers:

- To improve involvement and capacity building
  - increase the level of community representation
  - hold awareness raising sessions
  - increase support and training to community representatives
  - raise self-esteem of community representatives

- Information issues
  - introduce feedback sessions / mechanisms
  - upgrade IT and internet access for community members and have web based archive and notice board; e-resources and e-engagement techniques
  - develop a local advice and information neighbourhood base
  - agree a communication plan including consultation and engagement 'tool kit'

- Dealing with resource and time constraints:
  - appoint more community representatives
  - appoint more local staff
  - reprioritise and extend timescales

While a significant amount of effort was being invested in improving the capacity of public sector agencies to engage communities, there was little evidence of any change in the culture of agencies or transfer of power and decision making to communities. Further, it was not yet clear as to whether the activity was bringing about lasting changing in the effective engagement of the community in the planning and delivery of public services.

A subsequent Scottish review of the impact of community engagement and empowerment (Findlay, 2010) concluded that the process of engaging the community was vital in determining the outcomes that would be achieved. At the same time there was a need for organisations to be clear and more explicit about what they hoped to achieve through community engagement activity.

A more recent study of community engagement in neighbourhood regeneration (Jarvis et al, 2012) notes that comparatively, quality-of-life outcomes in deprived neighbourhoods have not improved significantly despite thirty years of policy-based intervention. The realities of delivering community-led regeneration have proved complex and the benefits difficult to capture in terms aligned to the requirements of evidence-based policy making. Despite this, it is argued that failure to engage communities makes sustainable regeneration challenging and less likely to result in positive outcomes. Community engagement is crucial in providing the building blocks for sustainable neighbourhood regeneration.

The comprehensive longitudinal study of community involvement in the New Deal for Communities (NDC) Programme [19] identifies a number of learning points that have a general relevance and reiterate many of the findings from previous studies:

- Resident involvement may peak towards the middle of a regeneration programme, and decline towards the end when resources have been spent and much of the focus moves towards succession and sustainability.

- There were important variations in rates of involvement:
  - Older, working age, adults were the most likely to be involved, while younger residents and those over retirement age were less likely
  - 20% of females had been involved in NDC activities, compared with 14 % of males
  - There was little difference between involvement rates for different ethnic groups

- Educational qualifications showed the biggest divide: 13% of those with no formal qualifications had been involved in activities organised by the NDC, compared with 21% of those with NVQ Level 5 or equivalent.

- A similar pattern emerges when looking at the characteristics of those who served as resident representatives on NDC boards. They were disproportionately male, over fifty and white, in households without children, employed (if working age) or retired, ‘middle class’, highly qualified, and long-standing residents of the area. The vast majority had previous experience in community organisations; either in a voluntary, or professional, capacity or in many cases both.

- Programme teams valued resident involvement because it brought insights into the concerns and needs of the local community. Although it was not always possible to reconcile the needs of the residents with those of professionals.

Maintaining involvement over time presented a considerable challenge and the evaluation identified a number of specific factors to support this:

- Have clarity about the aims and objectives of resident participation.
- Distinguish between community development, capacity building and engagement.
- Make sure there is a clear strategy for community engagement which highlights appropriate outcomes underpinned by capacity building and community development.
- If a programme is to be genuinely resident led and focused it must fully understand local needs before intervention is finalised.
- Resident involvement will change over time and strategies need to evolve to reflect this. When an NDC Partnership focused on its forward strategy it should have considered involving residents to support the next phase of work.
- Capacity building needs to be stopped at the right time: too soon and it may never be adequately developed, too late and the community may become over reliant on additional support.
- Partnerships need to have a staff team committed to community engagement with a strong leadership style and culture of openness.
- A community engagement champion at senior level can maintain the profile of community engagement and manage expectations of what can be achieved.
- Roles need to be clear so residents know where they fit within organisational structures.

- Offer a variety of engagement opportunities at a range of levels and accept at the outset that few residents will want to engage in formal decision-making processes.
- Developing a core group that can engage effectively. There can be a tendency for the ‘same old faces’ to be involved in community activity. This can be crucial for ensuring continuity and it is important to be realistic about the number of residents who will want to be involved beyond attending events. A further benefit is that a core group of residents will develop expertise and knowledge over time.
- It is important to provide support for residents who embrace the work. This might be through training, administrative support, IT support.
- Away-days can bring staff and residents together. Community engagement staff need appropriate knowledge, skills and experience for their role.
- Small grant programmes can be useful to pump prime development. These need to be carefully considered so they encourage sustainability rather than dependency.
- Use the strengths of other agencies in the area including schools and existing voluntary and community sector organisations especially those who can provide support to engage black and minority ethnic communities. It is important to bring in new/excluded groups to widen participation and avoid what are referred to as ‘negative network dynamics of closed groups’.
- Most of the 39 Partnerships felt that positive communication was central to their success, giving residents the chance to keep in touch with the work going on. They used a wide range of methods including newsletters, community radio, information shops, websites, leaflets and postcards, promotions and roadshows.

The evaluation of the NDC programme acknowledges that it does not provide clear evidence that resident participation contributed to the sustainability of interventions or improvements. It concludes that ‘Future programmes need clarity about the purpose and scope of resident involvement and to consider questions about local capacity, programme focus and resources, and the changing emphasis of involvement over time, before embarking on strategies to engage local people in regeneration processes.’ The way that community engagement is undertaken is of vital importance, otherwise there is the risk of negative and unintended outcomes.

6 Community engagement in energy related programmes

The role of community initiatives in embedding and implementing renewable technology at the local level has been examined (Gordon, 2007). The research included psychological analysis of survey responses by local residents, interviews at programme level and six project case studies. It was found that public acceptance of community renewable energy was generally high, but there was significant difference across areas. ‘Place’ mattered and both contextual and psychological factors were important e.g. whether the project was being led by a local community organisation and the previous history of social relations in the area. All the projects had made some impact on local peoples understanding and support for renewable energy, although there was no ‘best’ model to fit diverse local circumstances. It was concluded that positive outcomes were most likely to be ‘maximised where projects were led by local people or existing community groups, where there is already good social cohesion and where involvement and benefit are strongly collective in nature.'

Research exploring the role of five community based organisations in stimulating sustainability practice (Middlemiss, 2009) is critical of the tendency to look for 'one-size-fits-all' solutions. It is necessary to recognise the differing practices and values amongst individuals and that only certain types of people will join community organisations, the suggestion here being that it is volunteers with time on their hands. While community organisations can reach certain parts of the population it should not be assumed that they can effectively influence the practices of individuals much beyond their own membership.

A 2011 report on the support provided within the DECC 'Low Carbon Communities Challenge (LCCC)[20] notes the widespread recognition of the value of community engagement amongst community groups. However, several groups reported some initial reluctance within their communities and that support from the wider community was 'not a given.' Reluctance to getting involved might have been avoided if the community had been consulted and its support sought at the earliest opportunity and not, as happened in some instances, where community engagement was side-lined by other priorities. One project advocated encouraging community members to submit their own project ideas as one tool to be used in engaging the community. It was also the case that the assumptions held within community organisations leading the initiative did not always match those within the wider community.

A frequently overlooked issue was how the community was defined and who would benefit from the project. This was linked to the importance of being as inclusive as possible. There were some challenges as to the fairness of the initiative e.g. where some residents benefited from the installation of technology and others did not, or where there were negative impacts on part of the community such as noise from a wind turbine. Again, this was seen as emphasising the need for involving the community from the outset.

Community groups delivering projects like LCCC are well placed to gain trust from the community, though established groups can run the risk of being regarded as 'the usual suspects'. The importance of trust was highlighted by many groups, particularly those working with marginalised groups who might not otherwise engage with initiatives like LCCC. There was also a preference amongst the groups themselves to work with local, trusted partners.

The provision of facilitation support to keep community engagement 'on track' was particularly valued by those projects that saw this as one of the less tangible aspects of the initiative. It was necessary to manage community expectations of the project and to ensure that the benefits arising from the project were clear and perceived as being fair. In addition it was also important to help people see the change they were making, even if they were not originally motivated by environmental concerns.

A 2011 review of the Scottish Government's Climate Challenge Fund[21] identifies the key characteristics of successful projects including:

- Careful and realistic planning
- A good understanding of the target audience, including their motivations and barriers and how the proposed intervention will work in that context to change behaviour
- Messages that tapped into participant motivation, often non-environmental
- Interventions that activated motivations and helped overcome barriers. This included 'hand-holding participants to overcome barriers related to hassle and providing personal support to overcome inertia.

Again comment was made as to community projects being well placed to deliver pro-environmental change. This was due to their ability to tailor and personalise messages and interventions, being trusted and seen to have the communities' interests at heart. They could also engage those who were only 'moderately interested' in the environment (a substantial percentage of the population). In addition community scale environmental projects are at a meaningful scale for people; large enough to have an impact but small enough for people to feel they can make a worthwhile contribution.

In general, personal contact was more successful at engaging people in the initial stages of a project, rather than passive measures such as advertising, leafleting and the use of local media. Cascading engagement through existing groups and organisations could be effective, which might involve the use of a 'gatekeeper' to provide access and honing of the message. Finding the right gatekeeper was therefore important. Door-stepping and cold-calling over the phone tended to be disliked, though better received when the project was known to people.

Events focusing on 'green' topics mainly attracted those who already had a strong interest in environmental issues. This could be useful in identifying potential volunteers and members for the project's core group. Events also helped raise the profile of the project and remind people about it, though they might have might have minimal impact on overall behaviour change.

Written materials including regular newsletters worked best when the project's activities were varied and new things were happening. Newsletters could also help build a sense of community amongst participants particularly with a community of interest within a wide geographical area. Advice shops utilising empty shop premises were popular with projects providing a service, giving it a local base that participants can access. However, this could be a time-consuming activity.

The evidence from the review suggested that focusing on personal benefits of behaviour change was more effective than strong environmental messages[2]. This gave the projects wider appeal and enabled them to engage larger numbers of people. Mobilising people to take action on climate change was a process that takes time and the majority were happy to engage in project activity at a relatively shallow level. Community-led projects that built from the bottom up might take longer to gain momentum because of the time taken to

[2] The DNV-GL review found that environmental messages can also be quite effective (Section 3 point 4 - "Financial incentives can be effective but potentially need to be relatively large and impacts are often not sustainable over time; non-financial incentives should also be considered")

engage people, but had the potential to deliver a broader range of sustainable impacts in the long-term.

NESTA's 'The Big Green Challenge' awarded prizes to projects that sought to achieve measurable carbon reduction through community led innovation. The 2010 evaluation[22] of this initiative observed that 'an outcome based prize can provide the right incentives to stimulate results-focused community led innovation.' It raised ambition, mobilised community resources and 'got the best out of the community.' Funding and performance criteria could exert a positive influence on the effectiveness of community initiatives, while the provision of small grants to pilot innovative ideas enabled the subsequent selection of projects that were the most viable.

The ability for community based projects to engage people in behaviour change was shown, with 'untapped audiences' engaged at a more personal and intense level than could be achieved through a top-down approach. Some of the projects were able to inspire local people and create a real sense of purpose. The success of the projects was directly related to the capability and capacity of the community organisations involved and the quality of their leadership. Related to this was the need for organisational capacity building and support.

The challenge prize approach was adopted in the subsequent NESTA Neighbourhood Challenge.[23] An important part of the approach to engaging the community in the 17 neighbourhoods involved was holding conversations with local people to identify things they wanted to change in their community. These conversations were not through formal meetings; they encouraged people to talk about the contribution they could make to bring about change with a focus on their skills and enthusiasms. In many cases these conversations were led by local people who were supported and/or trained to initiate discussions.

A coaching or mentoring approach was employed to help individuals develop their ideas and in many cases this was provided by local community ambassadors or champions. A peer to peer method encouraged communities to draw on their own resources and supported the development of local networks. A key learning point identified about the conditions that enable community-led action, was the importance of developing a network of relationships that support and inspire, it being necessary to invest in processes that support relationship building.

A further key learning point was to find ways to shift the power balance to enable people to become change agents within their own communities. This was done through encouraging people to identify their own priorities, to provide the community with the opportunity to directly influence the ideas that were developed and receive funding to support local initiatives. It was also achieved by supporting and developing local leadership.

The meta-evaluation of the Impacts and Legacy of 2012 Olympic and Para Olympic Games [24] included an assessment of community engagement and participation in respect of sustainable living. One of the legacy objectives of the 2012 Games was to encourage people to live within the resources available, by reducing their carbon footprint, being energy efficient, making more sustainable travel choices and recycling on a greater scale.

It was considered that the Games provided a unique opportunity to encourage behavioural change, particularly by using it as a way to reach people who were interested in the Games but had not previously shown an interest in sustainability: 'Communication of sustainability messages, engagement with individuals and direct support for energy efficiency improvements would be expected to increase awareness of key sustainability messages and increase adoption of more sustainable behaviours, thereby contributing to a reduction in use of energy and other resources, an increase in recycling and increased use of more sustainable transport options.'

DEFRA provided seed funding for projects through the 'Inspiring Sustainable Living Fund' (ISL). These were delivered by third sector organisations, which supported and helped individuals and communities to adopt more sustainable behaviours. Two of the four ISL projects are of most relevance:

- The One Planet Experience Visitor Centre was located in Sutton and open to the public from October 2011 to March 2013. Visitors were encouraged to make energy saving pledges, with an average of seven being made by each person who took part. Follow-up surveys showed limited evidence of measurable behavioural change; however, those changes which appeared to have been most often implemented were those that were relatively simple and inexpensive to undertake, e.g. only boiling as much water as needed. People were less likely to have made a change where significant costs were involved, e.g. upgrading to an energy efficient boiler[3]. It was also noted that many visitors attracted to the centre already had a strong interest in the environment and so may have made some of the changes anyway.

- East Potential –Inspired to Sustainable Living. This included work to increase the uptake of sustainable behaviours amongst East Thames residents .The project began by holding a number of resident fun days but found these to be ineffective as a means to engage residents. Instead it contacted residents by letter with the offer of environmental resource packs, which were taken up by 765 households. In addition, volunteers were trained as environmental champions and supported delivery of the project, in particular by contacting residents to collect feedback on the packs and offer further advice.

Follow up surveys showed some evidence of behavioural change: 35% of those who had signed up for the packs reported increased levels of recycling as a result of taking part in the project, 23% reported reduced levels of energy consumption and 33% reported reduced water use. It was thought that the lower reported change related to energy consumption might be due to the relatively high levels of energy saving behaviours reported at the baseline stage.

[3] The DNV-GL review found that people with higher income may be willing to invest in more efficient appliances (Section 4.2 - Behaviours of different customer groups to reducing energy consumption)

The levels of engagement achieved by all four ISL projects suggest that the projects had played an important role in raising awareness about sustainable behaviours; however, evidence of outcomes in terms of actual and sustained behavioural change was more limited. All projects reported difficulties in securing survey responses and the resulting small sample sizes, particularly at the follow up stage limited their ability to identify and robustly assess behavioural change outcomes.

Research commissioned by DECC in 2013[25] on the potential roll-out of smart metering, considered among other questions, what are the best approaches to involving communities. The value of working with existing community groups was, as with other studies, highlighted; they could provide trust which might be considered lacking in current relationships between consumer and energy supplier. 'Green' community groups were a good vehicle for engaging people, though it should not be assumed that they could engage everyone as they attracted people interested in environmental and or energy efficiency issues.

Community groups were able to raise awareness within their neighbourhoods, providing a local perspective alongside national media campaigns. They also had a role in helping maintain momentum after the initial 'honeymoon' period and could be involved in providing practical support to households' e.g. basic advice on reading the monitor. The groups felt they needed and wanted more training to be able to provide this support and also more information in 'householder friendly language.' To work effectively it was better for project partners to agree needs and roles with community groups at an early stage.

An initial review[26] of the evidence of the impact of low-carbon community groups on individual, household and community use again identifies that community groups may be well placed to facilitate behaviour change. They can motivate and empower local people, develop niche innovations, change energy behaviours and encourage people to adopt energy efficiency and low carbon technologies and influence social norms.

The need to strengthen group capacity whether in terms of motivation, confidence, knowledge and or skills was an important but sometimes neglected aspect of successful behaviour change strategies. However, capacity building could be ineffective and disempowering if it failed to acknowledge or under-value the communities' own knowledge. This problem could be avoided by peer to peer learning between community groups and individuals. The review suggested that a community engagement strategy should include:

- Understanding and mapping of the community – its socio-economic make up, social networks and resources
- Ensuring the relevance, attractiveness, fairness of the offer to the community
- The relevance of messages for different types of individuals, tenure, socio-economic groups and or social networks of residents
- Efforts to address barriers to participation

A response to DECC 2013 call for evidence[27] on community energy identified a number of barriers which community-led energy projects faced. Lack of resources and reliance on volunteers, time constraints, not having a mandate, resources or skills to address issues / concerns or negotiate with landlords and not being able to access funds were all mentioned.

The carbon mapping of a community was one method that could be successful in increasing participatory engagement of local people and enabling community energy groups to target activity. Providing resources for shared learning e.g. visits to other communities, shared learning workshops, networking events and peer mentoring between communities could all stimulate interest[4]. Appropriate framing of messages including highlighting the practical, social and environmental benefits was helpful as was the use of innovative approaches to engaging the wider community.

In working with vulnerable communities and people in fuel poverty, direct engagement with residents could be effective; this included 'door-knocking' and 'handholding.' The use of multi-lingual representatives to convey messages in the most understandable way should be employed in working with multi-ethnic communities. In general information, training and skill sharing should be provided in an accessible way to the communities concerned.

The initial findings from a current three-year experimental study of a community-based initiative on household energy consumption (Bardsley et al 2013) have relevance for the SAVE community coaching trial. The study involves two matched areas, one as a control and the other where a community environmental group (CEG) has been formed of local residents with the aim of promoting environmental awareness. Households in both areas were offered simple energy saving measures including loft insulation and cavity wall insulation along with energy monitoring equipment. The only intervention in the first year was a two hour event run by the CEG for households in its area. There is evidence of a significant (around 10%) relative reduction in the level of power consumption that appears to have been sustained over a three month period in the CEG area. From this initial and limited intervention, it is suggested that there may be an important role for local community groups to run energy-focused events for households in their area.

The recent report on the Smart Communities project (Burchell et al 2014) is also of relevance to the SAVE community coaching trial. The project employed an action-research approach with the aim of encouraging the community to discuss and adopt new ways of doing things so as to consume less energy. However community discussion tended to reinforce rather than challenge existing ways of doing things. The focus was shifted to providing guidance by local experts and in-home demonstrations. This helped overcome a lack of energy know-how, which had been identified as a significant constraint to behaviour change.

Individuals joined the project for a number of often multiple reasons, with an interest in reducing energy consumption the most common, followed by a desire to save money and then to reduce carbon emissions. These accounted for over 90% of the reasons for joining, while 36% cited involvement in a community project as a reason. The decision to omit climate change from the framing of the Smart Communities project did not deter people and may have attracted those who might not have joined a project associated with it.

[4] The DNV-GL review found that workshops tend to have limited effectiveness (Section 4.4 - Workshops)

The level of participation and action varied amongst households, with an inverse relationship between the numbers of participants and the extent of participation; the higher the level of participation the fewer households were involved. However, over the two years significant levels of sustained engagement was achieved. The Smart Communities project was able to help develop local community energy networks through providing direct support and informing practical action by local groups and demonstrated that community action on energy can support behaviour change and energy efficiency measures. The research also highlighted the importance of understanding behaviour change as a long-term, gradual process.

7 Community engagement and social and behaviour theory

The question of what motivates people to get involved with community initiatives has been an area of enquiry for agencies concerned with community engagement and community development. A literature review undertaken by Involve[28] demonstrated that people's reasons for being active citizens varied greatly depending on their social, environmental and personal circumstances; the main reasons outlined were:

- 'A personal interest' or common interests
- An aspiration to change things
- Faith
- Exposure and access to community and voluntary sectors
- An opportunity to voice opinions

Additional factors that positively influence sustained participation levels included a settled personal life, higher levels of education, previous experience of participation and the friendships and networks created through previous participation. Social networks were an important factor in triggering the involvement of people. Other key triggers included 'being asked', 'word of mouth' and the influence of community motivators or 'moving spirits'.

This review also listed psychological motivations for civic activism and participation:

- Instrumentality: a desire to change circumstances
- Identity: to belong to a group
- Meaning: to give meaning to one's life

It concluded that, 'having a voice in the community and feeling a sense of empowerment gives citizens a stronger commitment to their local area. As a consequence they will be more likely to be a part of local activities….when an active interest is shown in their opinion...and they feel their engagement was influential and acted upon a citizen will be more motivated to be involved and stay involved politically.'

It is argued (Peters et al, 2012) that the concept of community represents a challenge in the research literature in respect of social change and environmental initiatives. However an understanding of inter-related concepts such as social norms, social learning and social capital is useful in providing a framework for the development of engagement strategies.

This relates both to the process by which personal and social norms develop and how information is individually and collectively processed.

Community action has the potential of being a strong force for social change and it is of crucial importance how this is encouraged and facilitated. Community engagement needs practical and pragmatic elements built into it from the start; a reliance on information provision will not be enough. A policy mix is required that includes both incentives and disincentives to coordinate individual and collective behaviour change towards more sustainable patterns of living. 'Trust and Knowledge are critical in the diffusion of social signals in promotion of changed behaviour patterns.'

Citing a number of studies, a report on the Smart Communities action research project (Rettie et al 2010) comments that there is now widespread agreement 'that community-level action is a potent resource for influencing energy and low carbon behaviour change.' Building on this work the Smart Communities project makes use of three conceptual frameworks:

- **Sociological practice theory** emphasises the 'habitual, routine nature of individual behaviour and the ways in which consumption is shaped by the broader sociotechnical context within which it takes place.' This identifies the need to address 'taken for granted' lifestyle practices, social norms and conventions in community low carbon projects.

- **Social norm approach** aims to influence behaviour by communicating what other people do. The research literature shows that by complementing individual household feedback on energy use with social group feedback, overall energy use can be positively influenced.

- **Community action research and practice** emphasises 'the experimental and contextual elements of learning and the role of informal interaction, such as that found in community projects, in building energy awareness.' Providing people with feedback on their energy use may not be enough alone. It is important to recognise the valuable knowledge and capacity within communities and to work within them and not upon them.

A 2013 review[29] of social network theory (SNT) and social network analysis (SNA) in relation to low-carbon communities suggests employing these approaches can be effective. SNA provides a way of thinking about communities that is not spatially bound, but takes account of network ties. It contributes to our understanding of how social learning and the adoption of innovation and ideas takes place via social interactions where one person imitates or is influenced by the behaviour of another.

SNA is also of relevance in relation to the engagement strategies used by community groups with network ties essential in recruiting and mobilising local people. The nature and extent of the organisational networks that community groups have influences their effectiveness in engaging people in taking collective community action. The influence of the group will also be influenced not only by its size but also by the density of the social ties within it.

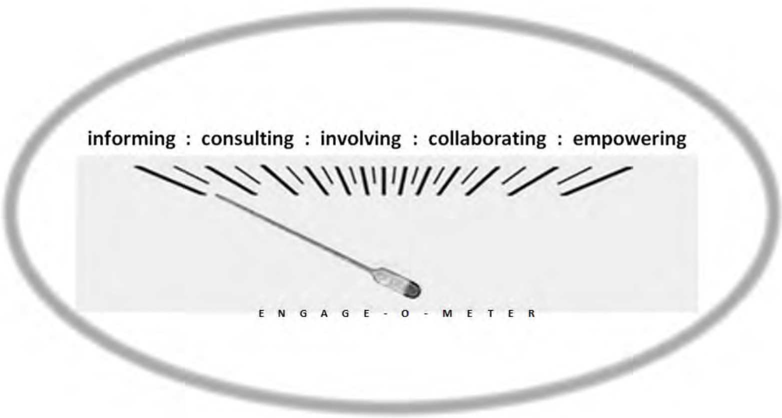
Social network theory looks at the role of strong and weak ties in diffusing information and or persuading people to adopt different behaviours. The diffusion of information is influenced by the number of network ties in the community, whereas it's the quality or strength of those ties that is important in behaviour change. Social networks have been shown to be significant in influencing adoption decisions and/or behaviour in relation to energy efficiency.

Social networks have an important role in relation to social norms, trust and credibility. Individuals are more likely to adopt pro-environmental behaviours if they think other people like them are doing the same. Possible sanctions resulting from not adhering to group standards, including exclusion from the group is a powerful motivator. Messages from credible or trusted sources and perceptions about the motivation of the information providers are likely to improve the uptake of novel technologies or new behaviours.

Understanding the characteristics of a community's social networks is of important value in planning and developing a community engagement strategy and developing and shaping networks to communicate and influence energy behaviours. It is also the case that community groups may need help in building social networks if they are limited or do not exist. Successful networks are likely to include both bonding links which help maintain trust *among* groups and bridging links that help make resources more accessible *between* groups.

8 Key Lessons for effective Community Engagement

The SAVE community coaching trial has adapted the 'ladder of community participation (Arnstein, 1969) to form a continuum with five styles of community engagement: **Informing – Consulting – Involving – Collaborating – Empowering**. This provides a ready structure for thinking about the key learning coming from this review that is of particular relevance to the community coaching trial[5].



[5] This is effectively an elaboration of the 'Engage' strand of action within the 6Es Framework described in the DNV-GL review (Section 2.2)

8.1 Informing

A difficulty with the ladder of community participation is that it implies a desired hierarchy, whereas a continuum helps convey the idea that there will be different styles of engagement in any project within a community – as per the 'Engage-o-meter' above accordingly devised for SAVE. This will be determined by factors such as the interest and values of the individuals concerned, as well as practical factors including the time they have available. The report of the Smart communities project (Burchell et al, 2014) employs an inverted pyramid of participation to demonstrate that most people will be involved at a relatively limited level, with only a relatively small number being fully engaged. Other studies evidence that the extent of involvement will change over time and that maintaining community engagement is an on-going task that requires flexibility. This highlights the importance of prioritising the use of the available time and resources within an overall planned strategy with clear community engagement objectives (Findlay, 2010) agreed by the project partners.

For many people just providing information about the project with up-dates may well be all they require or will have an interest in. However it's important to provide the opportunity for different levels of engagement reflecting people's differing capacity to be involved and their changes of interest over time.

There is a suggestion that simply providing information itself can have a significant influence on individual household energy consumption, at least in the short-term where this is provided by a local community group (Bardsley et al, 2013). Overall the evidence points to the need for a more active level of engagement. Relatively passive forms of communication in the initial stages of a project such as leafleting and the use of local media are less successful than personal contact. These can though have a role in helping to maintain involvement and interest when a project is underway.

Weakness in communicating and providing feedback has been an issue identified in a number of regeneration programmes. In part this can be addressed by regularly providing information in different formats and mediums. Consideration needs to be given to the demographics of the community[6]. Where there are a significant number of people from ethnic minorities it may be necessary to have information translated. Social media and web-based information are now common ways of communicating, but consideration has to be given to overcoming the 'digital divide' and access to information through these mediums.

8.2 Consulting

Time and resources for consultation have to be factored into the start-up phase of a project (LCCC).[30] It is important to review possible barriers and difficulties including how to consult with 'hard to reach' or vulnerable groups. Local community groups can help with access to those sections of the community that are often difficult to engage with. They will have

[6] The DNV-GL review found further customer characteristics that may help in categorisation purposes (Section 3 point- 1 – "Customer segmentations should actively assist in targeting campaigns effectively by focusing on differences in energy use, personal values and preferred methods of communication")

established social networks and be seen as having the interests of the community at heart, as such they are more likely to be trusted than external agencies or energy suppliers.

Community development is in part distinguished from other forms of community engagement by having a ‘bottom-up’ approach in which the needs and interests of the community inform project priorities. An embedded community coach should be guided by this principle, or the project will risk being perceived as only concerned with the targets and needs of outside agencies and energy suppliers.

It’s clearly important to ensure that the consultation is meaningful and that the community can genuinely influence what happens, not least to address any perception that the ‘agenda’ is already fixed. The evaluation of the LCCC identified the fact that support for environmental projects cannot be taken as a given, but consulting and seeking support as early as possible can help overcome this.

It is necessary to demonstrate a willingness to positively respond to what the community is saying. This will be more complicated if there are competing groups within the community or strongly divergent views. If there are uneven benefits and costs of project activities for sections of the community this can be a source of tension.

Consultation is not just about getting views about what is planned, but also as the project progresses responses as to what has happened. Implicit within this is an element of being accountable to the community for what the project has or hasn’t achieved. This may not be an easy concept for some project partners to accommodate particularly where it is seen to impinge of professional autonomy. This can be linked to a lack of a clear understanding amongst some partner agencies about what a community development approach involves (Burton et al, 2005).

8.3 Involving

The structures established for formal involvement of community groups and representatives should not be over-complex. At the same time there may be a value for having a structure that allows for different levels of involvement, recognising that not everyone will have the time or inclination to be involved in formal project or partnership meetings that are not infrequently described at grassroots level as ‘talking shops’. This can be associated with making too higher a demand on community representative’s time and helps to explain why community representation, particularly at board or partnership level, is frequently dominated by older males. The NDC evaluation notes as well as being over fifty years of age, board members were also disproportionately white and middle class.

Another recurring and linked perception, which often includes an implied criticism both from within the community and amongst professionals, is that community representation is just or mostly ‘the same old faces’ or ‘usual suspects’. If the process of electing or nomination community representatives is open and transparent, any such negativity can be mitigated. At the same time recognition could be given to the knowledge and experience these individuals bring with them.

There is a clear challenge in trying to ensure community representation reflects the composition of the area, or at least ensuring that efforts are made to be as inclusive as possible. Again, providing different ways in which people can be involved and have a voice within the project could help e.g. board membership or task group member. It will be important that if the project does have different levels of community representation that respective relationships are clear and representatives are well connected.

Some of the activities that community environmental projects have employed in attempting to raise awareness appear to have had little impact in changing individual or household behaviour. Workshops and events focusing on environmental issues not unsurprisingly tend to attract individuals who already have an interest in these matters and are less effective at engaging members of the wider community. More effective would appear to be personal engagement by individuals trained or equipped as environmental champions or local experts.

NESTA's challenge prize approach has been shown to be an effective engagement technique, but this relies on having a sufficient level of financial incentive and is not directly focused on achieving behaviour change. What arguably is more relevant is the importance given within the challenge prize process to developing a network of relationships and investing in support to develop these.

Demonstrating personal benefits such as financial savings on household fuel bills is likely to be more effective at involving people than the use of more altruistic messages about environmental gains. Framing project goals to include the potential positive impact on climate change would not seem particularly important (Burchell et al, 2014) [7].

There is evidence from the Smart communities project and practice theory (Rettiie et al, 2010) to argue for a focus on efforts aimed at influencing habitual routines as a means of achieving sustained individual environmental behaviour change. This has to take account of the social and technical context in which day to day behaviour takes place. Behaviour change is most likely in respect of relatively easy and small changes and where there is no significant household expenditure involved [8].

Individual involvement is also influenced by social norms. Providing information on what other households are doing within the community can have a positive effect on energy consumption and can be more effective than solely providing feedback on a household's own energy use.

The strength and scope of the social networks community organisations maintain are of significance in transmitting messages about social norms. Demonstrating the difference that individual households can make within the context of their local area will help to reinforce behaviour change. Involvement in a local project is easier for people to relate to and

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[7] The DNV-GL review found that environmental messages can be also quite effective (Section 3 point 4 - "Financial incentives can be effective but potentially need to be relatively large and impacts are often not sustainable over time; non-financial incentives should also be considered")

[8] The DNV-GL review found that people with higher income may be willing to invest in more efficient appliances (Section 4.2 - Behaviours of different customer groups to reducing energy consumption)

understand how their actions can have an impact than it will be for involvement in a regional or national environmental programme.

8.4 Collaborating

There is good evidence both from regeneration and energy related programmes as to the value of working through trusted local community organisations and groups. Investing time in mapping and understanding the community, the nature and extent of social networks of local organisations and community groups, the history of community participation and the existing representative structures is crucial. It should also include an assessment of the extent to which it is possible to build on existing structures of community involvement and in identifying a community group or organisation that can take on lead role in engaging with the wider community. This will entail some appraisal of its suitability including democratic legitimacy e.g. that it is not a self-selecting and closed group with no real claim to representativeness. However this should not entail setting higher levels of representation and accountability than exist amongst partner agencies.

Developing a shared ‘script’ for the project that clearly sets out what it hopes to achieve, how it will work and the benefits that will result, both social and environmental, will be of significant value. The central importance of community involvement within the project has to be highlighted and explained.

Partners agreeing a script for the project can usefully and, if timely, generate discussion and agreement as to respective roles and responsibilities. This process will help contribute to ensuring that the relationship between the community and groups representing it and with the project’s external partners is one of trust. It will be further facilitated by establishing decision making processes that are open and transparent and not dominated by the most powerful groups (Burton et al, 2005).

Evidencing that collaboration actually achieves tangible results that are relevant to the community is the basis for achieving sustained engagement. Giving prominence to the achievement of milestones, celebrating and broadcasting success is all part of this. Community ‘memory’ may be relatively short and achievements forgotten. Having a project archive that records the history and development of the project in a variety of forms will help address this.

8.5 Empowering

Difficulty in developing community confidence has been shown to be a barrier to effective community engagement.[31] Community representatives can feel disempowered when faced with working with confident professionals armed with technical expertise and the ‘verbal muscle’ that comes from being use to talking in public. They will be further disempowered by the use of jargon and complex terminology.

Capacity building through the use of training in such things as ‘speaking with confidence’ or computer skills can be empowering. Workshop sessions to ensure community representatives have a good understanding of different aspects of the project are also of helpful. Joint training workshops, away-days and similar activities involving community members, project workers and partners can also help build relationships and understanding. This in turn can contribute to more equal and confident exchanges between all partners.

The evaluation of NDC identifies the need for stopping capacity building at the right time to avoid an over-reliance on external assistance. What the right time is will clearly depend on fine judgement shaped by an assessment of any group's capacity. This also has to allow for new people getting involved in the project and assessing what their training needs may be.

Providing pre and post-meeting briefings to community representatives, particularly for high-level decisions e.g. at a board meeting, is a useful process than can build confidence. There is a danger of over-burdening individuals with too much information; providing good summaries and using accessible language helps address this. Presentations and opportunities for discussion contribute to community representatives being able to effectively participate in project meetings.

If an initiative is to be sustainable the level of external support provided over time will need to diminish and the community take increasingly take over responsibility. Though it will vary from area to area, the work that will be required to empower the community to get to this point cannot be underestimated and there may well be a need for some degree of support over the long-term.

9 Summary: key messages for Community Coaching

On the basis of this review, it is recommended that certain key principles and messages should underpin community engagement work to be undertaken as part of the trial. It is anticipated that specific good practice lessons may accordingly be further examined with a view to incorporation into the operational manual for the coaching trial to be co-produced with community-based organisations and other key stakeholders once the trial areas have been selected.

In accordance with the definition of 'what a coach does' (Section 2.2),[32] the key community engagement operational principles which should inform the community coaching trail can be summarised as follows:

9.1 Collaborate and resolve conflicts

A 'bottom-up approach - community coaching employs a 'bottom up' approach to community engagement which includes identifying local community organisations or groups to work with. It's not about attempting to get the community to simply sign-up to a set of pre-determined goals or targets. Instead it's a process of engaging the community to identify its concerns and interests so that these can inform what happens on a 'win/win' basis.

Understanding the community - to do this well the community coach has to have a thorough knowledge of the community, its history, the make-up of the area, the organisations and structures that operate within it and the issues that are important to it. The initial work of a community coach will involve a series of conversations with members of the community and other key stakeholders. It will also entail identifying at least one local community organisation or group that can play a lead role in ongoing engagement with the community.

Appreciating each partner - collaboration is about recognising and valuing what each partner contributes. A community coach will bring expert knowledge and access to resources; a community group will not only have knowledge about the area but also an established network of contacts that can start to facilitate 'win/win' engagement with the wider community.

Perceptions of fairness - a community coach will work to resolve conflicts that can occur when there are competing interests within the community. This can happen where there is perceived (and actual) unfairness in relative benefits and costs associated with the project e.g. only part of a neighbourhood receives free home energy installation. They may also have to address the tensions resulting from challenging energy consumption behaviours especially where they are part of the habitual routine of households and are seen as the norm.

Positive competition - employing forms of competition between communities or within a community, possibly incentivised, is a means of motivating behaviour change at both individual and collective level. It's important that any associated rivalry is managed appropriately to avoid any negative consequences. A skilled community coach will make sure this is the case and ensure any negativity is addressed before it becomes a significant difficulty.

9.2 Communicate

Using a variety of media - not only does communication have to be a two-way process, it has also to employ a variety of media that take account of the differing needs of members of the community. This includes the possible need for information to be translated and also account taken of the 'digital divide.' Social media offer a quick way of contacting a lot of people, but won't reach some members of the community, nor will e-mails. Passive forms of communicating such as leaflets and posters are less effective at engaging people than personal contact.

Accessibility of information - communication needs to employ accessible language and avoid overburdening people with too much and over complex information; the use of summaries and briefing presentations can help overcome this. Installations and demonstration sites such as visitors centre are also an effective way of conveying information about a project that can more readily engage people's interest.

The simple ask - at the most basic level simply asking people if they would like to get involved is an approach that can easily get overlooked. If this invitation comes from a trusted contact such as through a local community group it is more likely to get a positive response than from a relatively unknown source.

The local dimension - the importance of communicating the local nature of the project should not be underestimated. Individuals are much more inclined to engage with something that has direct relevance to them and where their participation is contributing to outcomes they can see, than with a national environmental programme where their involvement is seen as making little, if any difference.

An engaging message - messages that directly relate to the known interests or concerns of the community or individuals will be more effective at prompting a response than more general ones. While some people will have a strong interest in environmental issues, messages that convey enlightened self-interest e.g. the financial savings of reducing the household's carbon footprint, will engage with more people.

Consistent and persistent messaging - it's important to ensure messages from the project are consistent. Agreeing a script that is used by everyone communicating about the project is a necessity and having a communication strategy a good idea. This should ensure that lines of communication both internal to the project and with the community and external stakeholders are clear and effective. It has to also identify what are the priorities for communicating messages about what is happening, the progress and successes of the project. The community won't stay engaged if the project isn't achieving tangible outcomes relevant to it; these need to be communicated and celebrated. Over time people should be reminded about them in order to sustain involvement. This can be linked to where individuals or households have made 'pledges' to make changes in their environmental behaviour and have sustained these, possibly with the awarding of prizes or other forms of community recognition.

9.3 Build capacity

A long-term, gradual process - capacity building is a long-term process that is essential to empowering the community so it is able to be an active partner in achieving sustainable environmental behaviour change. It is a process that involves working with local community partners to enhance and develop their social networks as the basis for widening engagement. Often it is a case of working in the first instance with community representatives who are 'the same old faces,' but gradually over time trying to ensure that representation and involvement better reflects the whole community including the vulnerable and 'harder to reach' groups. The better a project is able to do this the greater legitimacy it will be seen as having.

The confidence gap - a community coach will work with community representatives to enhance their capacity to effectively engage with the project. In part this is premised on recognising the frequent disparity between the confidence of community representatives and the professional workers they are working with. This may result from differences in levels of expertise or knowledge, but also the level of experience individuals have of being involved in working meetings and speaking in public. Arranging pre and post-meeting briefings for community representatives will help build confidence and ensure they have an effective voice.

Training needs assessment - undertaking a training needs assessment will offer people an early activity that looks to establish what training and support needs community members involved with the project or lead community group have. As the project develops and new people become involved it will be necessary to provide opportunities for them to undertake relevant training. Drawing on the experience of community members who have already undertaken training and are experienced in working with the project can be empowering. At the same time it is important that capacity building and the support provided by the community coach does not foster dependency on the worker and is withdrawn or reduced at an appropriate time.

9.4 Strengthen relationships

Shared vision - working together to create a shared vision for the project and jointly agreeing priorities, ways of working, and roles and responsibilities will create a sense of joint ownership between the community and with the project's other stakeholders. This development work will happen early on in the project's life. The use of away-days, workshops or similar activities that allow for greater social interaction between stakeholders than would normally be possible through project meetings is usually a good way of building win/win relationships.

Building trust - creating and strengthening trust has to be a key concern at all levels. Joint training involving community members, project workers and other stakeholders can also be a good way of developing working relationships. Organising social events that mark key stages in the project's life and celebrate achievements will also contribute to strengthening relationships and building trust.

Reaching the wider community - through local community partners a community coach will work to extend the reach of the project to engage with the wider community and 'harder to reach groups'. This cannot simply rely on providing information about the project. The use of fun-days and innovative activities that both raise the profile of the project and create opportunities for getting involved can be of value in helping to build and strengthen relationships with the community.

9.5 Identify and connect to resources

Intrinsic local resources - identifying and harnessing local resources will be an important task for the project. Foremost amongst these will be the skills, knowledge and experience of people from within the community. This can have a multiplier effect in terms of the impact of the project through individuals' direct involvement as volunteers in one form or another. It can also be in relation to initiatives spinning out from project activities such as the development of new forms of voluntary action or income-earning social enterprises. Helping identify and/or create funding streams for this type of local development can contribute to sustaining positive environmental outcomes.

Evidence of impact - the more inclusive the project is able to be with a breadth of different stakeholders involved, the better its chances of potentially accessing additional funding streams. This will be important in establishing the long-term sustainability of the project and might include trust and grant funding as well as earned income through public and private sector commissioning. This underlines the importance of monitoring project outcomes and overall impact to evidence the business case for securing new and additional resources.

9.6 Reflect and change

Collective learning - as well as providing opportunities for training as part of capacity building, community coaching also involves a process of collective learning. As a relatively new approach to working with communities, it's particularly important to not only record project outputs but to assess outcomes and the processes that have led to these. This will be an on-going activity that provides the project with regular information to reflect and learn from, enabling changes to be made to the project as necessary. It has to be as objective as possible and recognise the value of learning not just from what has worked, but also from anything that has not: success is good, failure is not bad!

Objective local evaluation - it's important that learning is built into the project from the outset. Equally representatives of the project's stakeholders should be involved in identifying the questions that need to be asked about its progress and contribute to assessing the objective evidence that answers them. Again, this will create a sense of ownership of the learning process which will help ensure that the learning outcomes inform ongoing change.

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REPORT

Appendix 1.6.4
Network Investment Tool (NIT) Instruction Manual

technology

Prepared for: SSEN

Report No: 93210
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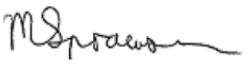
Business Approval	17/09/2019	1.2	

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1. Definitions

This table defines any abbreviations used within this report.

ADMD	After Diversity Maximum Demand
BSP	Bulk Supply Point
CM	Customer Model
DLL	Dynamic Link Library
DNO	Distribution Network Operation
DUoS	Distribution Use of System
EV	Electric Vehicle
HP	Heat Pump
HV/EHV	High Voltage/Extra High Voltage
LCT	Low Carbon Technology
NIT	Network Investment Tool
NM	Network Model
PM	Pricing Model
PV	Photo Voltaic
SAVE	Solent Achieving Value from Efficiency
UoS	University of Southampton

2. Introduction

This document services as an instruction manual for the Network Investment Tool (NIT). The Network Investment Tool was developed during SSEN's Solent Achieving Value through Energy Efficiency (SAVE) project.

The SAVE project produced a Network Investment Tool that allows DNOs to assess and select the most cost-efficient methodology for managing electricity distribution network constraints. The NIT considers the effectiveness of different types and degrees of energy efficiency interventions, as well as more traditional techniques for network reinforcements as tools for the management of networks by DNOs.

2.1 Application Architecture

The NIT tool has a Microsoft Excel front end and a Microsoft Access backing. As depicted in Figure 1, communication between these two is via a suite of DLLs, which manage the bulk of the business logic including running the DEBUT and EGD engine, which are discussed in section 2.2.

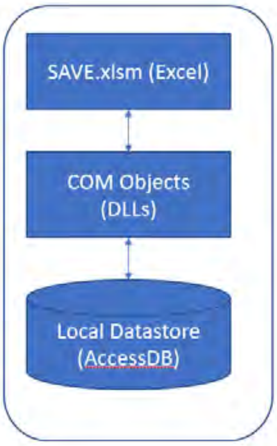

Figure 1 NIT architecture

The tool has been designed with the intention that all user interface will take place through the Microsoft Excel environment and the management of the data within the local datastore will be an activity undertaken by the model administrator.

The Excel user interface provides users with 5 types of analysis, which are known as:

- Single Assessment
- Future Assessment
- Multi-Scenario analysis
- A tariff calculation module
- A storage price comparison module
- HV/EHV module

These five analysis options are implemented over 18 Microsoft Excel worksheets. There are a further 13 Microsoft Excel worksheets which can be used to manipulate network data, customer data, growth assumptions or study settings.

To assist in navigation, the relationship between the local datastore and tabs within the user interface are summarised in Figure 2.

Output reports are published on the Microsoft Excel worksheets listed in each of the 5 assessment areas.

It is important for the reader to understand that functionality which reviews the low voltage network is supported by load flow analysis packages whereas the functionality which reviews the high voltage network is limited to an aggregated model of customer effect and has no load flow analysis facility.

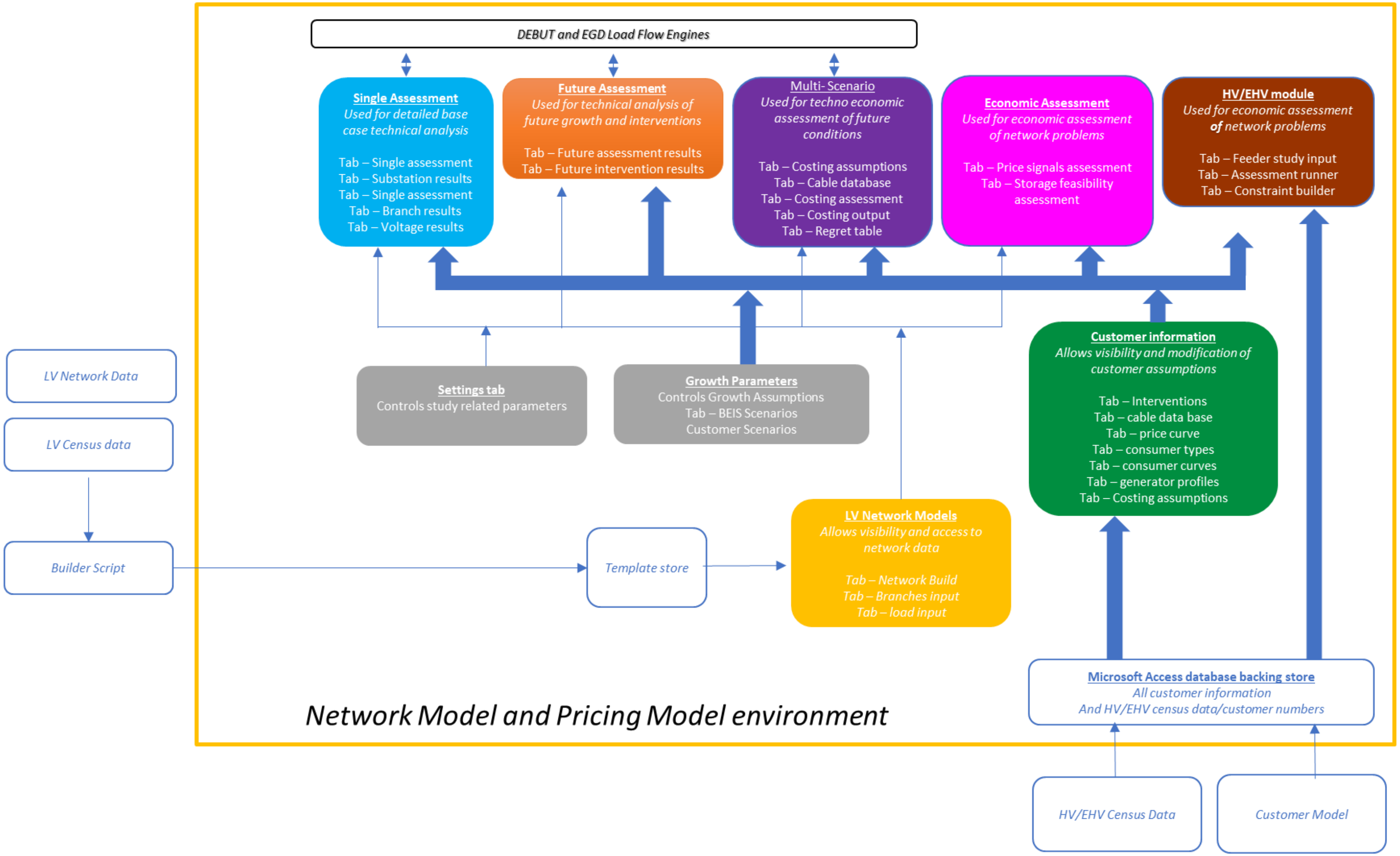

Figure 2 NIT functional diagram

2.2 Load Flow Engines

The Debut and EGD load flow engines are both commercially available within the commercially available WinDEBUT package. This manual seeks to outline how the Network Investment Tool utilises these load flow engines and any implications on the application of this tool. A full explanation of the assumptions of these tools can be found within the WinDEBUT instruction manual. These load flow engines are contained within the DLL's of the tool.

It is important to understand that the NIT only employs load flow engines for analysis of the Low Voltage network.

DEBUT is a mature software package that provides voltage drops and asset utilisations from customer load models. Developed by EA Technology, it is implemented in Fortran and, unlike most load flow tools, DEBUT uses a unique calculation process to take account of diversity following the ACE 49[1] design method and is able to solve networks without having to resort to iterative methods which can sometimes have difficulties converging on a solution.

DEBUT does not consider generation and will only return the expected network duty on the basis of the ACE49 design demand. DEBUT does not calculate load flows at a 30-minute resolution but instead reports on the periods of worst-case loading for each day.

EGD is an iterative load flow package which can consider the effect of embedded generation on load flows. Because EGD is an iterative package, it is not able to replicate the ACE49 approach to design demand and instead uses the average demand per user as a basis for each 30-minute period of the day.

Because of the difference in treatment of diversity between EGD and DEBUT, users should be aware that the results from EGD and DEBUT will not be comparable unless the terms used by DEBUT are removed.

In all cases, users can choose between the use of just DEBUT or use DEBUT and EGD in parallel. If users choose to only run DEBUT, the results will ignore the presence of all generation.

This document does not replicate the WinDEBUT user manual and assumes that users have a familiarity with these packages.

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[1] ACE 49 refers to ACE 49; ENA, 1981. "Report on Statistical Method for Calculating Demands and Voltage Regulations on LV Radial Distributions Systems", Energy Networks Association, 1981. This document outlines a standard for designing LV networks including a process for the treatment of diversity between customers.

3. Settings and growth

3.1 Settings Tab

The settings tab is used to control certain study assumptions or annunciate settings that have been set from within the Microsoft Access Database. The parameters within the settings tab are as follows:

- Debut File Path. This defines where the debut files are kept
- Keep Old Assessment Files For (Days). This defines how long Debut study files will be retained for.
- The Global Scaling Factor, enables users to scale up or down customer loads, albeit this is set to 100%
- Fault level voltage, this is as per the WinDEBUT manual
- Consumer voltage, this is as per the WinDEBUT manual
- Voltage criticality grading. Voltage criticality is assigned a colour banding depending on nodal voltage in comparison to the nominal voltage. These fields are set in the Microsoft Access Database, hence are not intended to be readily adjustable by daily users. Each of these fields is set in terms of its percentage deviation from nominal voltage.
- Loading criticality grading. Loading criticality is assigned a colour banding depending on circuit loading. These fields are set in the Microsoft Access Database, hence are not intended to be readily adjustable by daily users. Each of these fields is set in terms of its percentage deviation above the maximum acceptable circuit load.

3.2 BEIS Scenarios and Custom Scenarios Tab

The Network Model also allows the user to express the expected percentage uptake of Low Carbon Technologies (LCTs). The Network Model will then simulate this uptake over time, by the addition of the following technologies to an LV network:

- Heat Pump demand profiles
- Electric Vehicle demand profiles
- Photo Voltaic generation profiles

To reflect the potential growth of low carbon technologies, users are able to declare rates for the expected uptake in Heat pumps, Electric Vehicles and Photovoltaic generation under low, medium and high assumptions for a set of assumptions labelled as BEIS and also as custom. These assumption sets described the expected percentage penetration of each technology type within the domestic properties in the model.

There are two worksheets (BEIS Scenarios and Custom Scenarios) that contain lookup tables that specify percentage uptake of Heat Pumps and Electric Vehicles by year and a growth rate (Low, Medium or High). When building a study a corresponding proportion is added for the number of consumers specified (e.g. if a point load has 10 consumers with HP uptake of 17% and EV uptake of 33%, then 2 HPs and 3 EVs are added for the node only whole numbers are allowed, so rounding will occur).

These assumptions can be entered on the tabs known as BEIS Scenarios and Custom Scenarios. The purpose of the BEIS scenarios tag is to replicate government-sanctioned assumptions. The purpose of the customer scenarios tag is to enable user-led assumptions.

Year	PV Low	HP Low	EV Low	PV Medium	HP Medium	EV Medium	PV High	HP High	EV High
2017	1.02%	0.21%	0.54%	1.61%	0.21%	0.69%	2.20%	0.20%	1.30%
2018	1.08%	0.26%	0.80%	1.80%	0.26%	1.11%	2.50%	0.30%	2.00%
2019	1.15%	0.73%	1.14%	2.05%	0.73%	1.70%	2.90%	0.70%	2.80%
2020	1.26%	1.52%	1.56%	2.37%	1.53%	2.45%	3.40%	1.50%	3.80%
2021	1.30%	1.64%	2.08%	2.64%	2.35%	3.40%	4.10%	2.30%	5.20%
2022	1.37%	1.76%	2.67%	2.94%	3.54%	4.51%	4.90%	3.30%	6.80%
2023	1.44%	1.88%	3.34%	3.27%	4.98%	5.78%	5.80%	4.80%	8.60%

Figure 3 Example of LCT growth scenarios tab

For each year and technology within the growth forecast, users may specify a low, medium or high assumption for penetration (i.e. the proportion of customers on a feeder who have adopted the technology). Users may specify a growth rate up to the year 2060.

To allow the NIT to allocate EV, PV or HP to the study, load profiles for this technology must be declared as per sections 4.3 for generation or section 4.2 for EV and HP.

4. Customer Information

The NIT utilises the WinDEBUT customer representation of holding a set of load curves which express the behaviour of domestic customers. These customer load curves express, for each 30 minute period of a day, the:

- average power consumption within a population of the same customer type
- the standard deviation of power consumption, within a population of the same customer type

The reader is referred to the WinDEBUT manual for further detail on this representation.

Unlike WinDEBUT, the NIT facilitates users to study the effect of customer targeted energy efficiency interventions. This is done by holding a load curve for each customer type under both:

- base case conditions, for a number of representative days across the seasons
- situations, where domestic customers help, deliver energy efficiency interventions, for the same representative days across the seasons

4.1 Consumer Types Tab

The NIT gives a summary of the customer types that have been made available within the Consumer Types tab of the tool. An example of this tab is shown in Figure 4.

Each customer type is described in terms of

- A profile code
- A reference number
- A description of the customer load curve
- A CP number, which is used as a reference

All of these descriptions are user-configurable and would be entered by the individual responsible for managing the load curves.

Profile	Ref No	Description	CP Number
EAB	118	Base Load,Electric,4+Bed	CP18
EEB	117	Base Load,Electric,3Bed	CP17
EIB	115	Base Load,Electric,0-1Bed	CP15
EVSUMW	901	EV (Do not remove)	CP49
EZB	116	Base Load,Electric,2Bed	CP16
GAPAB	114	Base Load,Gas,4Person,4+Bed	CP14
GAPEB	113	Base Load,Gas,4Person,3Bed	CP13
GAPZB	112	Base Load,Gas,4Person,0-2Bed	CP12
GEPAB	111	Base Load,Gas,3Person,4+Bed	CP11
GEPEB	110	Base Load,Gas,3Person,3Bed	CP10
GEPZB	109	Base Load,Gas,3Person,0-2Bed	CP09
GIPAB	104	Base Load,Gas,1Person,4+Bed	CP04
GIPEB	103	Base Load,Gas,1Person,3Bed	CP03
GIPIB	101	B-Base Load,G-Gas,IP-1Person,IB-0-1Bed	CP01
GIPZB	102	Base Load,Gas,1Person,2Bed	CP02
GZPAB	108	Base Load,Gas,2Person,4+Bed	CP08
GZPEB	107	Base Load,Gas,2Person,3Bed	CP07
GZPIB	105	Base Load,Gas,2Person,0-1Bed	CP05
GZPZB	106	Base Load,Gas,2Person,2Bed	CP06
HPWIN	902	HP (Do not remove)	CP50
OAB	122	Base Load,Other,4+Bed	CP22
OEB	121	Base Load,Other,3Bed	CP21
OIB	119	Base Load,Other,0-1Bed	CP19
OZB	120	Base Load,Other,2Bed	CP20

Figure 4 Consumer Types summary worksheet

4.2 Consumer Profiles Tab

This tool assumes that domestic customers will be grouped into groups of similar types.

Under base case conditions, the customer model acknowledges that the observations of the difference in power consumption patterns between similar users will vary on a random basis. For this reason, the load profile for each customer group is defined in terms of:

- The mean average power consumption, per half-hour period, across a group of similar customers. These groups of similar customers are referred to as customer types.
- The standard deviation per 30-minute period across a customer type.
- To enable 365 days per year analysis, each customer type will be modelled using a 30-minute resolution of the mean average power consumption and the standard deviation consumption for the following profiles: winter weekday, Saturday and Sunday, spring and autumn weekday, Saturday and Sunday and summer weekday and Saturday and Sunday.
- Alter the diversity assumptions for each section of the LV feeder to be proportional to the number of customers connected beneath each branch.
- Implement the requirements of ACE 49 in setting the design demand to meet the 90% probability of meeting demand expectation.

For each customer type, the data is required to be populated as shown in Table 1.

A graphical representation of the p and q values is also shown in Figure 6. It should be noted that due to limitations within DEBUT, the maximum number of customer types should be limited to 48.

To allow HP and EV technology to be allocated to the feeder in accordance with any growth specified. A load profile for HP and EV must be declared. EV shall always be allocated to profile number 901 and HP shall always be allocated to profile 902.

Table 1 Customer data format

Heading	Description
Season	The season type that applies to the displayed profile. The available values are WINTER, SPRING, SUMMER, AUTUMN
Day	The day type that applies to the displayed profile. The available values are WEEKDAY, SATURDAY, SUNDAY
Consumer Type	The consumer type reference. This is a unique value of between three and six upper case alphabetic characters
Consumer Ref No	A unique numeric value that is used in the DEBUT
Description	Free text description of the consumer type. Can be left blank
Growth Factor Weighting (0-100)	A weighting factor applied to growth. This is used to dampen annual growth by consumer type. A value of 0 indicates that no annual growth is to be applied. 100 applies the full growth. Typically, this value would be set to 100
Consumer CP Code	This is a unique cross-reference value used in the HV module to map consumer types. Values are prefixed CP followed by a two-digit number (using a leading zero where required e.g. CP01)
Price Signal Success Rate	A weighting factor used when calculating transformer and feeder costs of price signals
Diversity Weighting (Default 100%)	A weighting factor applied to the q value to determine the diversity
No of Light Bulbs (HV)	The number of lightbulbs used by this consumer type for HV calculations
Lightbulb Recruitment Assumption (HV)	A weighting factor used in the HV module to indicate the percentage of consumers recruited for a low energy lightbulb campaign
Data Recruitment Assumption (HV)	A weighting factor used in the HV module to indicate the percentage of consumers recruited for a data-led engagement campaign
Coaching Recruitment Assumption (HV)	A weighting factor used in the HV module to indicate the percentage of consumers recruited for a community coaching campaign
CMZ Recruitment Assumption (HV)	A weighting factor used in the HV module to indicate the percentage of consumers recruited for a price signal campaign
Half Hour	A number between 1 and 48 indicating the half-hour bucket
Time	The start time of each half-hour bucket
p(W)	Consumption p-value for this half-hour
q(W)	Consumption q value for this half-hour

Season	WINTER
Day	WEEKDAY
Consumer Type	GEPEB
Consumer Ref No	110
Description	Base Load,Gas,3Person,3Bed
Growth Factor Weighting (0-100)	100
Consumer CP Code	CP10
Price Signal Success Rate	100.00%
Diversity Weighting (Default 100%)	100.00%
No of Light Bulbs (HV)	10
Lightbulb Recruitment Assumption (HV)	100.00%
Data Recruitment Assumption (HV)	100.00%
Coaching Recruitment Assumption (HV)	100.00%
CMZ Recruitment Assumption (HV)	100.00%

Half Hour	Time	p (W)	q (W)
1	00:30	283.8	368.896
2	01:00	267	314.368
3	01:30	241	262.4
4	02:00	217.6	221.696
5	02:30	221.4	249.344
6	03:00	205.4	207.36
7	03:30	209.8	221.696

Figure 5 Example of Consumer Profile within the Network Model

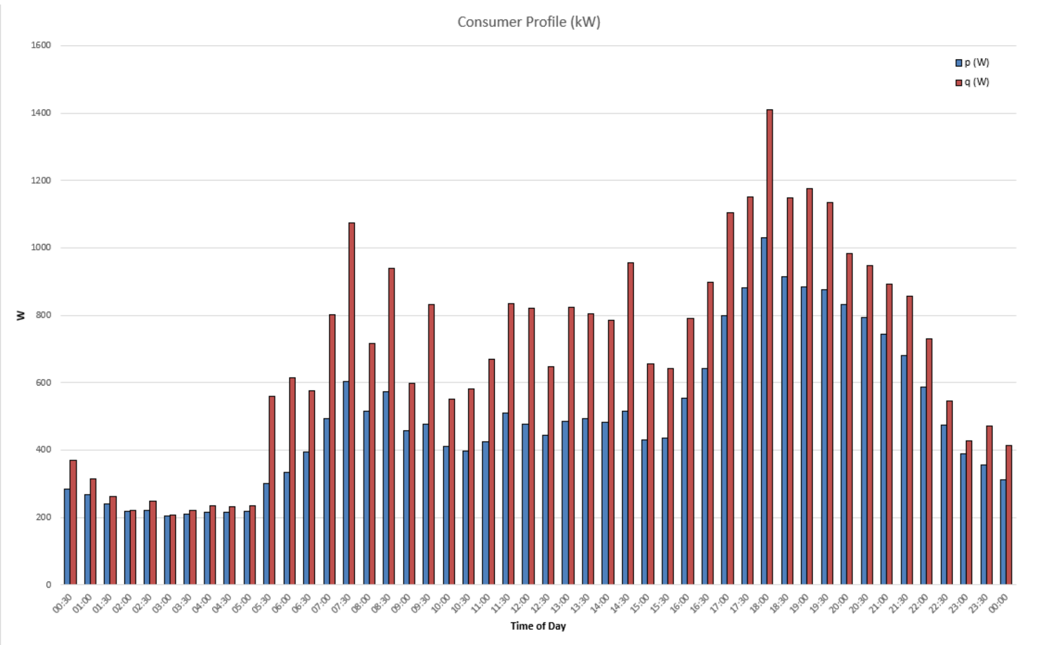


Figure 6 Example of Consumer Profile graph within the Network Model

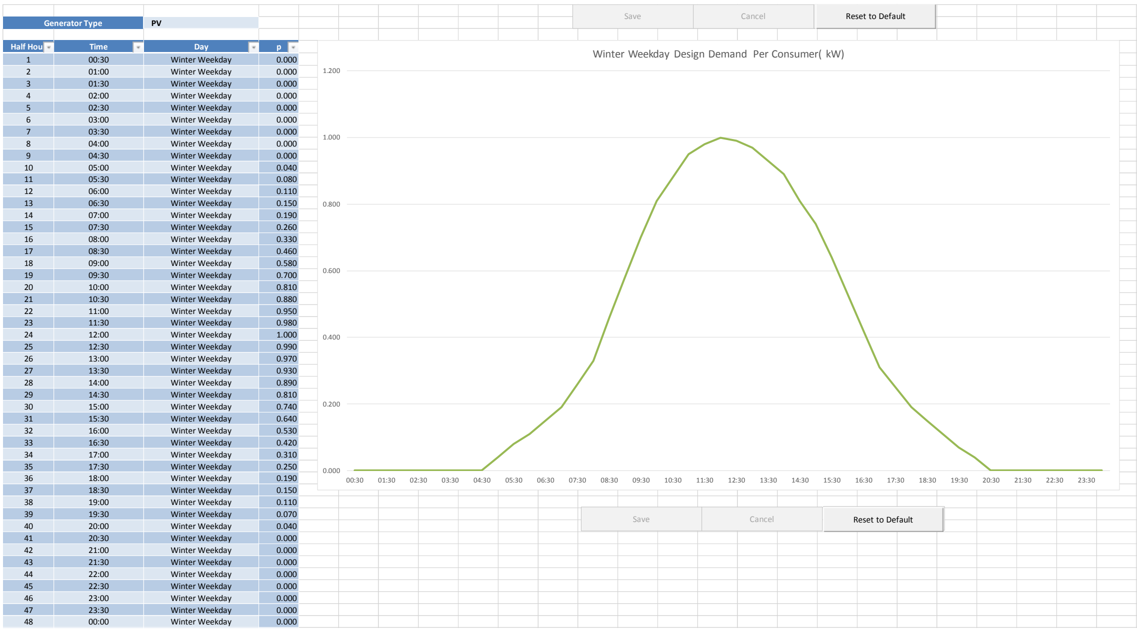
4.3 Generator Profiles Tab

The Generator Profiles worksheet allows generation to be modelled on a half-hour basis and also on a year-round basis. These profiles are held in the backing store, but users can interact with or create these profiles via the Generator Profiles worksheet.

Examples of the interface to these load curves are shown in Figure 7. These curves are used during analysis of LV networks. These profiles are applied where the generation has been declared in the base case model or when growth scenarios choose to apply new generation in future years. In these cases, new generators are declared within the model, in accordance with the LCT uptake growth assumptions that are specified by the user.

The output profile of these new installations is scaled up or down to meet any LCT size assumptions that have been stipulated by the user.

Unlike the representation for consumers or electric vehicles and heat pumps, generators are specified in terms of p values only (average 30 minute period output within a population); no standard deviation is applied hence no diversity in output is assumed between PV generators.



Generator Type: PV

Half Hou	Time	Day	p
1	00:30	Winter Weekday	0.000
2	01:00	Winter Weekday	0.000
3	01:30	Winter Weekday	0.000
4	02:00	Winter Weekday	0.000
5	02:30	Winter Weekday	0.000
6	03:00	Winter Weekday	0.000
7	03:30	Winter Weekday	0.000
8	04:00	Winter Weekday	0.000
9	04:30	Winter Weekday	0.000
10	05:00	Winter Weekday	0.040
11	05:30	Winter Weekday	0.080
12	06:00	Winter Weekday	0.110
13	06:30	Winter Weekday	0.150
14	07:00	Winter Weekday	0.190
15	07:30	Winter Weekday	0.260
16	08:00	Winter Weekday	0.330
17	08:30	Winter Weekday	0.460
18	09:00	Winter Weekday	0.580
19	09:30	Winter Weekday	0.700
20	10:00	Winter Weekday	0.810
21	10:30	Winter Weekday	0.880
22	11:00	Winter Weekday	0.950
23	11:30	Winter Weekday	0.980
24	12:00	Winter Weekday	1.000
25	12:30	Winter Weekday	0.990
26	13:00	Winter Weekday	0.970
27	13:30	Winter Weekday	0.930
28	14:00	Winter Weekday	0.890
29	14:30	Winter Weekday	0.810
30	15:00	Winter Weekday	0.740
31	15:30	Winter Weekday	0.640
32	16:00	Winter Weekday	0.530
33	16:30	Winter Weekday	0.420
34	17:00	Winter Weekday	0.310
35	17:30	Winter Weekday	0.250
36	18:00	Winter Weekday	0.190
37	18:30	Winter Weekday	0.150
38	19:00	Winter Weekday	0.110
39	19:30	Winter Weekday	0.070
40	20:00	Winter Weekday	0.040
41	20:30	Winter Weekday	0.000
42	21:00	Winter Weekday	0.000
43	21:30	Winter Weekday	0.000
44	22:00	Winter Weekday	0.000
45	22:30	Winter Weekday	0.000
46	23:00	Winter Weekday	0.000
47	23:30	Winter Weekday	0.000
48	00:00	Winter Weekday	0.000

Figure 7 Example of PV load profile

Customer information may be placed into the Network Model either by loading it into the backing store or by manually declaring a new customer and profile within the customer information parts of the environment.

The Network Model represents the network year-round by using load profiles for each consumer that relate to seasonal days (i.e. winter weekday, winter weekend, spring weekday and spring weekend etc). This means that each consumer type must have a full set of seasonal load profiles created so it can be represented year-round.

The output profile of these new installations is scaled up or down to meet any LCT size assumptions that have been stipulated by the user.

During the analysis of future growth scenarios, the NIT will allocate LCT to be connected at locations along the feeder. The Network Model will decide the quantity and location of LCT in a manner that is decided by the assumptions that are selected with the load growth assumptions worksheet.

Photovoltaic generation is modelled on the basis of average generation, across the population, per 30 minute period, per representative day, as shown in Figure 7.

4.4 Erosion Factors Tab

The Erosion Factor worksheet specifies the decay effect applied to consumers over a period of 20 years. It gives a weighting factor against the consumer ‘p’ value which is applied to SAVE interventions. The range of this value is 0 to 100%. 100% indicates that the full SAVE intervention is to be applied; 0% indicates that the SAVE intervention has no effect on consumption. For example, for a half-hour period, a consumer type has a consumption value of 300W and a base intervention effect of 10W. For year 0, the erosion factor is 100%, so the full effect of the SAVE intervention is observed (that is 300 – 10 = 290). For year 1, the erosion factor is 80%. This would reduce the effect of the SAVE intervention to 8 (10 x 80%), so the observed consumption would increase to 292 (300 – 8). If in year 12, the erosion factor is 0%, then the observed consumption would be 300.

4.5 Interventions Tab

The interventions tab, allows users to specify how energy efficiency interventions change the base customer load curve.

This modelling data is used in different ways depending on whether an LV model is being used or whether an HV model is being used. There are differences in these approaches because the approach to LV modelling is based upon load flow analysis whereas the HV model takes an approach which aggregates the expected effect of energy efficiency.

For each 30 minute period, for each characteristic day, for each customer type and for each energy efficiency intervention, there should be a record that describes how much power should be subtracted from the base case customer load profile. This information can be entered into the backing store and visualised on the Interventions tab an example of which can be seen in Figure 8.

The effect of energy efficiency interventions is simulated by subtracting the effect of the energy intervention from the average demand associated with each 30 minute period for the customer type in question. The effect of energy efficiency interventions shifting of demand can be simulated by putting in negative values to this field.

In the figure below, the intervention appears to have a varying effect in different half-hour buckets. For example, the intervention at 07:30 has a negative effect (causes consumption to increase by 80W), whereas at 17:30 it has its maximum effect.

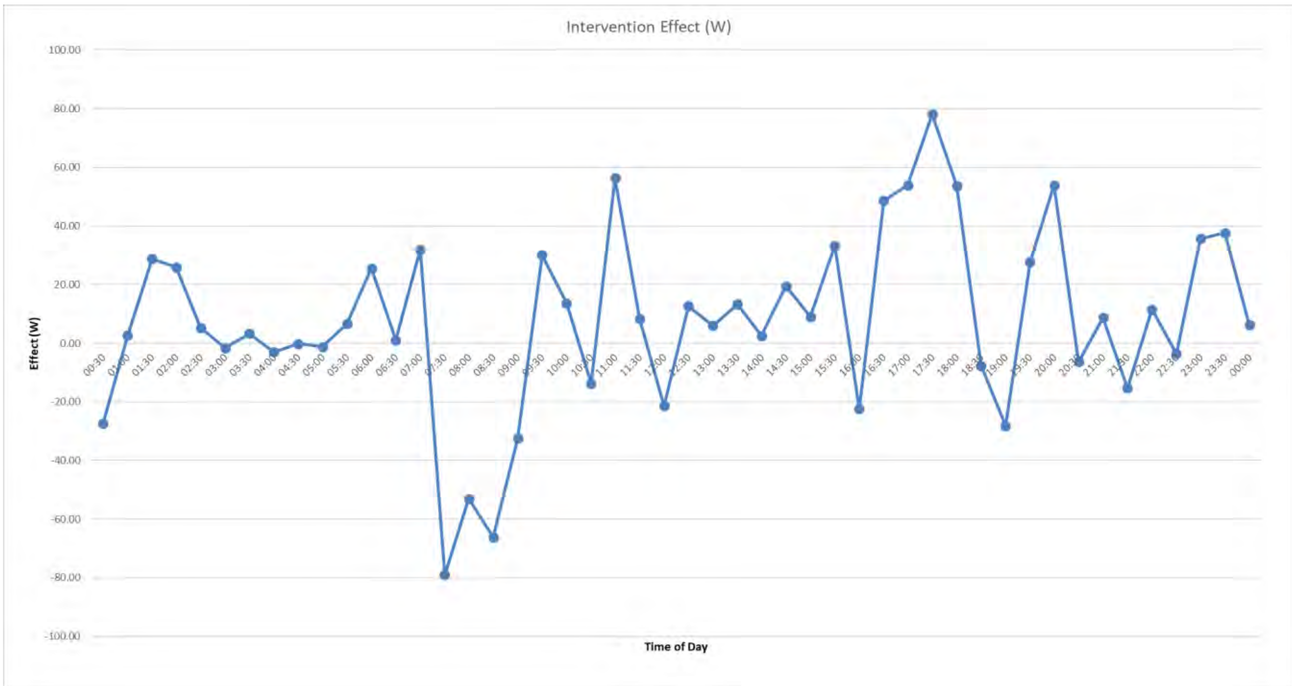


Figure 8 Example of Intervention Profile

4.6 Price Curve Tab

To enable price signals to be used as an intervention, each customer type can be represented by an elasticity relationship.

The elasticity relationship determines the amount of "turn down" in electrical power consumption that each customer type would be expected to give under winter peak consumption conditions for a given price signal. These assumptions reside within the backing store and should nominally be controlled by the administrator. Users can also update price curves and assign them to customer types through the interface shown in Figure 9.

The price curve approach uses the banded model of pricing signals that were trialled as part of the SAVE project. Further detail behind this approach can be found in Appendix I.

For the price curve functionality to work, a price curve assumption to each consumer type.

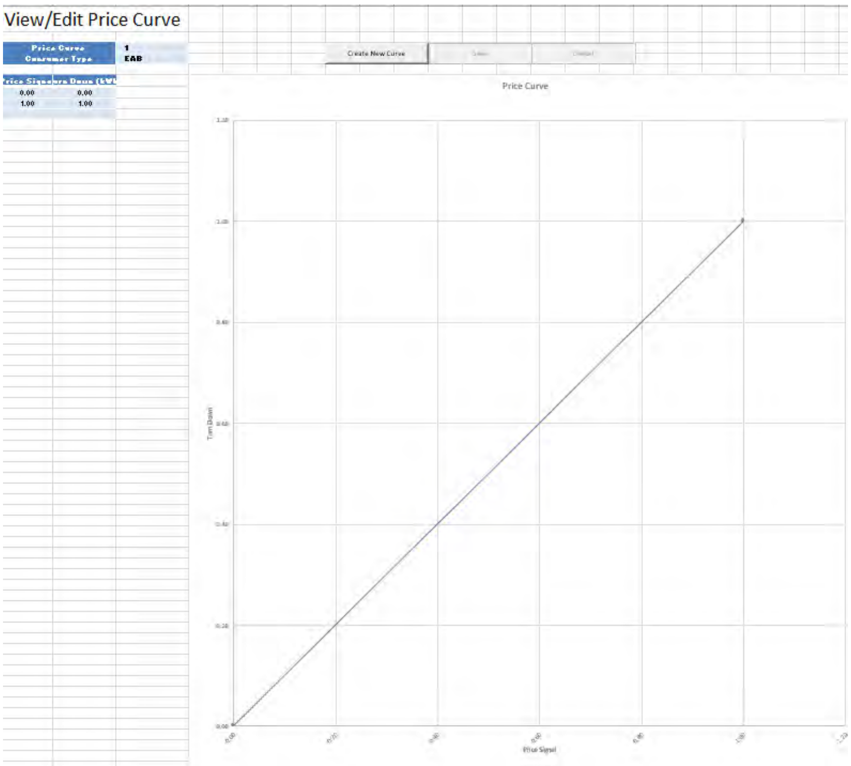


Figure 9 Example of customer price elasticity curves

Before an assessment, users will also have to assign a global banding price signals in the price signals assessment worksheet, as shown in Figure 9. These bandings set the targets beneath which customers do not respond to price signals.

These bandings may be set on the cost assumptions tab.

Price Signal	Insensitive Below Target
0	0
0.15	0.15
0.25	0.35
0.35	0.5
0.45	0.75

Figure 10 Example of customer price banding

The methodology behind the banded price signal is described in Appendix I.

4.7 Cable Database Tab

The NIT has a requirement to populate the tab known as Cable Database within the excel user environment with technical and economic details that are invoked when the user conducts either future analysis or the multi-scenario analysis. An example of this tab is shown in Figure 11.

Cable Uprate

Cable Type	Rating	Overhead?	Cost per metre	Cost per MPAN	Mobilisation/Fixed Cost	Selectable?
CU 0.5	570	No	600.00	0.00	7200.00	Yes
WAVE 185	335	No	270.00	0.00	7200.00	Yes
WAVE 300	435	No	280.00	0.00	7200.00	Yes
WAVE 600	870	No	560.00	0.00	7200.00	Yes
WAVE 999	1700	No	1120.00	0.00	7200.00	Yes

Figure 11 Example of Cable Database tab

This table uses the following fields:

- Cable Type is the name of the cable
- Rating is the winter peak rating of the cable
- Overhead, declares whether this conductor is overhead or underground.
- Cost per metre is the cost to install one metre of this cable
- Cost per MPAN is the cost to move one customer service to the new mains cable
- Mobilisation/Fixed cost is the fixed cost in pounds of commencing a project with this size cable, regardless of length.
- Selectable, declares whether this cable is a choice that can be used by the multi-scenario analysis when deciding viable interventions.

As per Appendix B of the Debut user guide, it is assumed that users will configure the program data text file to contain the required parameters for each cable type expected to be used on the network. The data text file is stored within the tool directory and is in addition to the Excel user interface, the template store and the local database.

The information fields declared on this tab are in addition to the data text file required by DEBUT to. All cables declared on the cable database tab, must be mirrored by an entry in the Debut data file.

5. LV Network Information and Template Store

A network template contains a description of one Low Voltage substation and its feeders.

- The HV/LV substation is described in terms of the rating and impedance of the transformer.
- Each feeder fed from the substation is described as a connectivity tree of nodes and branches
- The connectivity structure of each feeder is plotted by a sequence of nodes, which have customers connected to them
- Two ended branches link each node to the next, from the source substation to the remote ends of the feeder. Each branch of a feeder is described in terms of length, impedance, winter peak rating.

Network Templates are stored within a folder known as the template store. Network Templates are created and stored as a .CSV file.

This tool has been created with the expectation that a methodology which replicates the methodology employed by SSEN on their SAVE project, which uses a census model to allocate customer types, as described in 4, to nodes in the network template. Use of these tools allows the administrator to create network templates that can allocate the right customers to the right location on a feeder. Alternatively, users may build their own templates without using the SAVE process.

In either case, users may load network data by either creating a .csv template using the format described in Table 2. The user is encouraged to review the WinDEBUT manual for further information and context behind this format.

5.1 Network Build Tab, Branches Inputs Tab and Load Input Tabs

This section introduces the data format for declaring a network template. A network template is a collection of rows within a .CSV file, an example of which can be seen in Figure 12.

Each row of the .CSV file defines a starting and end node, the branch linking the two nodes and the customers connected to each branch.

SUB=100 500														
1	11	1	TRIPLE	CONSAC 1	0	0	0	0		0			MAIN	ON
2	68	206	TRIPLE	CU 0.1	12	0	0	0	GAPAB	1000	AUTO		MAIN	ON
3	70	31	TRIPLE	CU 0.25	3	0	0	0	GAPAB	1000	AUTO		MAIN	ON
4	125	12	TRIPLE	WAVE 30(	0	0	0	0		0			MAIN	ON
11	14	129	TRIPLE	CU 0.1	4	0	0	0	GAPEB	1000	AUTO		MAIN	ON
11	12	56	TRIPLE	CU 0.1	0	0	0	0		0			MAIN	ON
12	13	75	TRIPLE	CU 0.1	2	0	0	0	GAPEB	1000	AUTO		MAIN	ON
14	21	5	TRIPLE	CU 0.1	0	0	0	0		0			MAIN	ON
14	15	1	TRIPLE	WAVE 95	0	0	0	0		0			MAIN	ON
15	16	6	TRIPLE	WAVE 95	1	0	0	0	GAPEB	1000	AUTO		MAIN	ON
16	17	28	TRIPLE	CU 0.06	0	0	0	0		0			MAIN	ON
17	20	89	TRIPLE	CU 0.06	4	0	0	0	GAPAB	1000	AUTO		MAIN	ON
17	18	13	TRIPLE	CU 0.06	0	0	0	0		0			MAIN	ON
18	19	78	TRIPLE	CU 0.06	4	0	0	0	GAPAB	1000	AUTO		MAIN	ON
21	22	84	TRIPLE	CU 0.3	3	0	0	0	GAPAB	1000	AUTO		MAIN	ON
21	38	58	TRIPLE	CU 0.06	0	0	0	0		0			MAIN	ON
22	45	45	TRIPLE	CU 0.1	0	0	0	0		0			MAIN	ON
22	58	9	TRIPLE	CU 0.1	0	0	0	0		0			MAIN	ON
22	23	11	TRIPLE	CU 0.1	0	0	0	0		0			MAIN	ON
23	24	1	TRIPLE	CU 0.1	0	0	0	0		0			MAIN	ON

Figure 12 Example of a network template in a .CSV format

The format for each row of a .csv file is introduced in Table 2. Users are encouraged to refer to the WinDEBUT manual for a full description of the workings of this data format. Unlike the full WinDEBUT. In contrast to the WinDEBUT package, the NIT tool does not support the distribution of customers along a branch and instead demands that customers are only connected to nodes. Users are also reminded that the satisfy both the EGD and DEBUT load flow engine limits the maximum number of customers that may be connected to a node is 7.

A network template that has been loaded into the template store can be selected and loaded by using the Network Build tab as shown in Figure 13

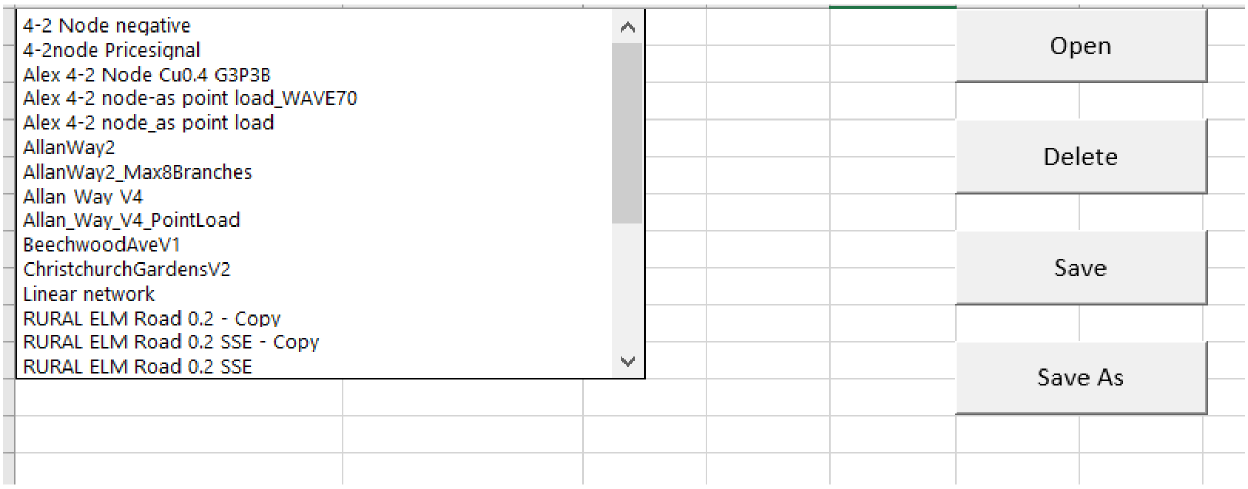


Figure 13 Network Build Tab

The top box within this figure shows the list of networks that are available for study. The second box lists the demographics of customer types within this model. Each customer type e.g. GAPAB, relates to a customer type from the Customer Model.

Table 2 Data format for templates

Heading	Description
Near Node	The ID number of branch node nearest to a network source. This ID number must be allocated by the user. Each node can accept more than one branch.
Far Node	The ID number of nodes furthest from the source. This ID number must be allocated by the user. Each node can accept more than one branch.
Length	Branch length in metres
No of Phases	Number of Phases
Cable Type	Reference to the cable type. This entry must relate to one of the cables specified in the Cable Database worksheet
Number of Customers	Number of customers connected to Far Node
Red Imbalance	Either blank or the percentage to be applied to the red phase. If entered, the total of red, yellow and blue phases must add up to 100
Yellow Imbalance	Either blank or the percentage to be applied to the yellow phase. If entered, the total of red, yellow and blue phases must add up to 100
Blue Imbalance	Either blank or the percentage to be applied to the blue phase. If entered, the total of red, yellow and blue phases must add up to 100
Customer Type	Reference to customer load profile. This profile must relate to one of the profiles declared in the Consumer Types worksheet
Annual Consumption (kWh)	Annual consumption of the customer type. This is a required value and must be more than 100 to interface with the basic assumptions of the customer model created by the SAVE project this must be set to 1000.
Phase Sequence	Either set to AUTO, or the order in which consumers should be allocated to the phases
Balanced	YES if balanced otherwise blank
Main / Service	Branch purpose i.e. LV main or service

Heading	Description
Status	ON if this node is to be included in the study

Users also have access to the Branches Inputs worksheet (Figure 14) and the Load Inputs (Figure 13) worksheet to either:

- view the structure of the network and customers
- build custom models and save them.

These tabs replicate the fields declared in Figure 3.

Transformer Rating [kVA]	500
Substation Node	100

Near Node	Far Node	Length (m)	No of Phases	Cable Type	Main / Service	Status
1	11	1	TRIPLE	CONSAC 185	MAIN	ON
2	68	206	TRIPLE	CU 0.1	MAIN	ON
3	70	31	TRIPLE	CU 0.25	MAIN	ON
4	125	12	TRIPLE	WAVE 300	MAIN	ON
11	14	129	TRIPLE	CU 0.1	MAIN	ON
11	12	56	TRIPLE	CU 0.1	MAIN	ON
12	13	75	TRIPLE	CU 0.1	MAIN	ON
14	21	5	TRIPLE	CU 0.1	MAIN	ON
14	15	1	TRIPLE	WAVE 95	MAIN	ON
15	16	6	TRIPLE	WAVE 95	MAIN	ON
16	17	28	TRIPLE	CU 0.06	MAIN	ON

Figure 14 Example of Branches Inputs worksheet

							Phase Imbalance				
							Red (%)	Yellow (%)	Blue (%)		
Node	Type	No of Consumers	Consumer Type	No of Phases	Phase Sequence	Balanced	Red (%)	Yellow (%)	Blue (%)	Annual Consumption (kWh)	Status
68	BRANCH	12	GAPAB	TRIPLE	AUTO					1000	ON
70	BRANCH	3	GAPAB	TRIPLE	AUTO					1000	ON
14	BRANCH	4	GAPEB	TRIPLE	AUTO					1000	ON
13	BRANCH	2	GAPEB	TRIPLE	AUTO					1000	ON

Figure 15 Example of Load Inputs worksheet

A key feature of the Load Input worksheet is the ability to allocate loads to phases to simulate a global phase imbalance target. This allows users to replicate customer phase allocation based on observations made at the source substation.

5.1.1 Use of Phase imbalance facility

The DEBUT load flow engine has a facility to allocates customers using an algorithm to balance the load across the available phases. However, it has a facility to allow a specific number of customers to be allocated to specific phases (and override the allocation process) for point loads (but not branch loads).

The NIT furthers this function by enabling users to specify a target level of phase imbalance. To create a phase imbalance for a specific branch, the percentage of customers required for each phase must be entered, so that the total entered is 100%. This is then built into the input file to be passed to DEBUT.

To specify the same imbalance for all point loads, enter the percentages in the cells in row 3. These can be individually overridden as above.

Note that when an imbalance is specified, an extra row will be added to the input file, which could take the number of entries for a node beyond the DEBUT limit of 9.

The phase imbalance information forms part of the template so will be saved.

The phase allocation can also be configured by specifying the phase sequence. If this value is set to AUTO, then the allocation of consumers is determined by DEBUT. If the user wishes to override this, then selecting a phase sequence from the drop-down list will cause the number of consumers to be allocated in the selected order. For example, if there are two consumers at a node and the phase sequence is set to RED-YELLOW-BLUE (for a TRIPLE phase node), then the two consumers specified will be allocated to the red and yellow phases – leaving the allocation as AUTO would mean that the two consumers would be allocated to two phases, but the user would have no control over which ones interface with Customer Model

As per Appendix B of the Debut user guide, it is assumed that users will configure the program data text file to contain the required parameters for each cable type expected to be used on the network. The data text file is stored within the tool directory and is in addition to the Excel user interface, the template store and the local database.

6. Single Assessment

6.1 Introduction

The Single Assessment function of the Network Model allows users to study the duty on a network. This can be based on a specified season and type of day (typically winter weekday as the time of year network capacity is most likely to peak and when resultant SAVE interventions were run) or for a full year (of the four seasons and the three-day types – Weekday, Saturday and Sunday).

This assessment is suited to studying base case conditions without any network development or additional load from heat pumps or electric vehicles.

6.2 Single Assessment Tab

An example of the input area for this study is shown in Figure 17, after nominating these selected parameters, users may initiate analysis by selecting the Run Assessment button.

The two study options available are DAY or YEAR. When DAY is selected, the Season and Day are then available to be selected.

DAY runs a single DEBUT study for the selected season and day. YEAR runs twelve DEBUT studies (one for each combination of season and day) and amalgamates the results. The results are then populated into the Substation Results, Branch Results and Voltage Results worksheets.

For each study that is run, consumer profile data for the relevant season and day type is used. If a consumer profile has not been created for a season and day type combination that is required, then an error message as shown in Figure 16 is displayed identifying the missing consumer profiles (a maximum of 15 messages). The assessment cannot be run until the required missing consumer profiles have been created (or the consumer profiles have been removed from the study)

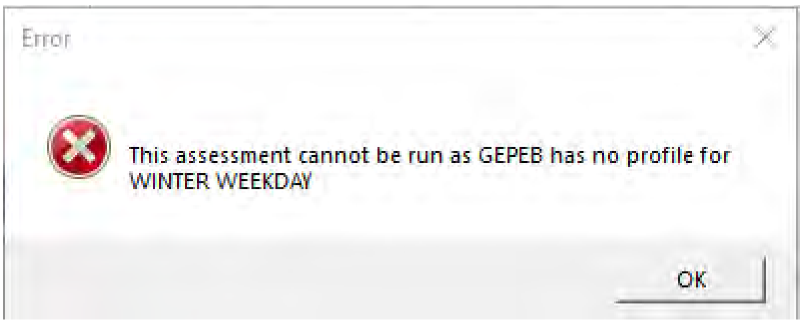


Figure 16 Error message for missing Consumer Profile

Study Options	DAY
Season	WINTER
Day	WEEKDAY
Include EGD?	No

Figure 17 Example of Single Assessment input

Users are also presented with a choice of approach for use of the load flow engines. EGD can be included in the assessment by setting the 'Include EGD?' flag to Yes. If set to No, then the assessment will run DEBUT only. This means that the study will disregard the presence of any PV generation.

If the 'Include EGD' flag is set to yes, then all reports will be modified to provide output from both EGD and DEBUT

The Single Assessment worksheet provides an overview of the results presented in more detail on the Substation Results, Branch Results and Voltage Results worksheets.

Examples of this overview are shown in Figure 18 and Figure 19.

Results Summary										
Last Run	19/07/2019 10:55									
Debut Input Files	C:\SAVE\assessments\I_SINGLE_ASSESSMENT_2019_2019-07-19--10-55-19_*_*									
Debut Output Files	C:\SAVE\assessments\O_SINGLE_ASSESSMENT_2019_2019-07-19--10-55-19_*_*									
Max Tx Util (%)	90.02									
Tx Hours Over Rating	0									
	Volt						Current Overload			
Feeder Number	Max Drop (%)	Max Rise (%)	Lower Red	Lower Amber	Upper Amber	Upper Red	Max (A)	Amber (m)	Red (m)	Longest (m)
1	2.9	0.00	0	0	0	0	0	0	0	0
2	6.7	0.00	0	0	0	0	0	0	0	0
3	1.3	0.00	0	0	0	0	0	0	0	0
4	7.8	0.00	0	0	0	0	0	0	0	0
5	0.5	0.00	0	0	0	0	0	0	0	0
6	2.5	0.00	0	0	0	0	0	0	0	0

Figure 18 Example of Single Assessment results overview with EGD

Results Summary							
Last Run	19/07/2019 10:54						
Debut Input Files	C:\SAVE\assessments\I_SINGLE_ASSESSMENT_2019_2019-07-19--10-54-25_*_*						
Debut Output Files	C:\SAVE\assessments\O_SINGLE_ASSESSMENT_2019_2019-07-19--10-54-25_*_*						
Max Tx Util (%)	90.02						
Tx Hours Over Rating	0						
	Volt			Current Overload			
Feeder Number	Max Drop (%)	Lower Red	Lower Amber	Max (A)	Amber (m)	Red (m)	Longest (m)
1	2.9	0	0	0	0	0	0
2	6.7	0	0	0	0	0	0
3	1.3	0	0	0	0	0	0
4	7.8	0	0	0	0	0	0
5	0.5	0	0	0	0	0	0
6	2.5	0	0	0	0	0	0

Figure 19 Example of Single Assessment results overview without EGD

These overviews provide:

- The maximum transformer utilisation within the day including the number of hours the transformer is outside its rating.
- For each feeder, the maximum feeder voltage drop.
- For each feeder, the maximum feeder voltage rise (when EGD is included).

- For each feeder, the distribution of customer criticality who are receiving voltages outside of tolerance. (when EGD is included both lower and upper criticality are included; when not only lower criticality)
- For each feeder, the length of each feeder where the circuit loading exceeds criticality limits.

This overview worksheet allows a high-level review of how congested a feeder is, but at an information resolution which talks generally about the entire feeder without explaining where the congestion is or how long it persists for.

6.3 Substation Results Tab

The substation report provides a load versus time graph of the load upon the substation. The report also provides the results in tabular form with the half-hour period of peak load highlighted. This report replicates the substation loading in line with the calculation basis from WinDEBUT.

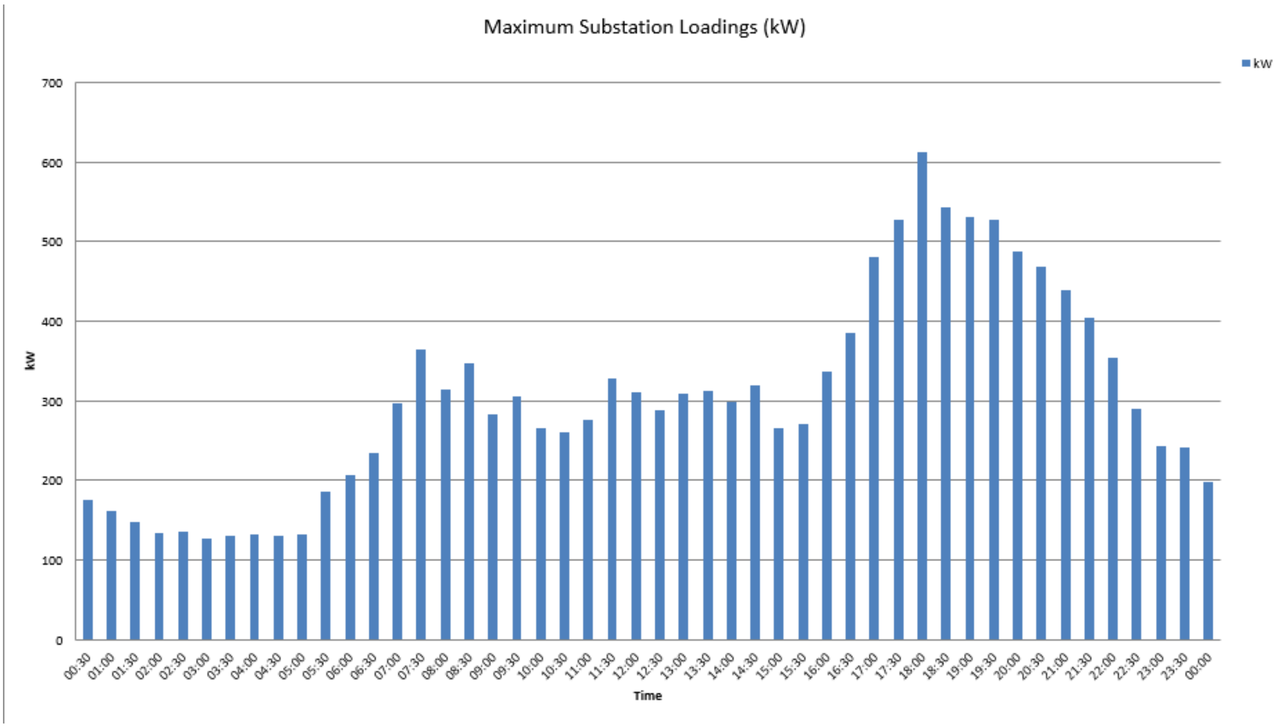


Figure 20 Example of Substation Results Report for Single Analysis

6.4 Branch Results Tab

The Branch Results reports are shown in Figure 21, with the EGD output, and Figure 22 without it. This report shows a row for each branch in the model.

The first 12 columns of each of the Branch Results report confirming the construction details for each branch. The remaining columns of the report show the value of maximum current load and the time, day and season upon which it occurred. The additional fields within the EGD report show flow direction (without EGD will always be Downstream) and tolerance per phase.

Note that the number of consumers, consumer type and phasing count relate to consumers defined as being along a branch.

Feeder Number	Near Node	Far Node	Length	No of Consumers	Consumer Type	Phasing: Red	Phasing: Yellow	Phasing: Blue	Number of Phases	Cable Type	Rating (Amps)	Maximum Current: MC Time	Maximum Current: MC Day	Maximum Current: MC Season	Maximum Current: Maximum Current (A)	Flow Direction	Above Overload Red Limit (Red Phase Hours)	Above Overload Red Limit (Yellow Phase Hours)	Above Overload Red Limit (Blue Phase Hours)	Within Overload Amber Limit (Red Phase Hours)	Within Overload Amber Limit (Yellow Phase Hours)	Within Overload Amber Limit (Blue Phase Hours)	Within Nominal Green Band (Red Phase Hours)	Within Nominal Green Band (Yellow Phase Hours)	Within Nominal Green Band (Blue Phase Hours)
1	100	1	4	0		0	0	0	TRIPLE	WAVE 185	335	18:00:00	WEEKDAY	WINTER	86.3	Downstream	0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00
1	1	11	299	0		0	0	0	TRIPLE	CU 0.15	290	18:00:00	WEEKDAY	WINTER	86.3	Downstream	0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00
1	11	101	1	0		0	0	0	TRIPLE	WAVE 300	435	18:00:00	WEEKDAY	WINTER	60.9	Downstream	0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00
1	11	102	1	0		0	0	0	TRIPLE	WAVE 300	435	18:00:00	WEEKDAY	WINTER	36.8	Downstream	0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00
2	100	2	5	0		0	0	0	TRIPLE	WAVE 185	335	18:00:00	WEEKDAY	WINTER	164.5	Downstream	0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00
2	2	12	317	0		0	0	0	TRIPLE	CU 0.25	395	18:00:00	WEEKDAY	WINTER	164.5	Downstream	0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00
2	12	13	42	0		0	0	0	TRIPLE	CU 0.1	240	18:00:00	WEEKDAY	WINTER	108.9	Downstream	0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00
2	13	14	88	0		0	0	0	TRIPLE	WAVE 95	235	03:00:00	WEEKDAY	WINTER	0		0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00
2	13	15	77	0		0	0	0	TRIPLE	CU 0.1	240	18:00:00	WEEKDAY	WINTER	100.3	Downstream	0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00
2	15	16	32	0		0	0	0	TRIPLE	CU 0.1	240	18:00:00	WEEKDAY	WINTER	90	Downstream	0.00	0.00	0.00	0.00	0.00	0.00	24.00	24.00	24.00

Figure 21 Example of Branch Results Report from Single Analysis with EGD

Feeder Number	Near Node	Far Node	Length	No of Consumers	Consumer Type	Phasing: Red	Phasing: Yellow	Phasing: Blue	Number of Phases	Cable Type	Rating (Amps)	Maximum Current: MC Time	Maximum Current: MC Day	Maximum Current: MC Season	Maximum Current: Maximum Current (A)
1	100	1	4	0		0	0	0	TRIPLE	WAVE 185	335	18:00:00	WEEKDAY	WINTER	86.3
1	1	11	299	0		0	0	0	TRIPLE	CU 0.15	290	18:00:00	WEEKDAY	WINTER	86.3
1	11	101	1	0		0	0	0	TRIPLE	WAVE 300	435	18:00:00	WEEKDAY	WINTER	60.9
1	11	102	1	0		0	0	0	TRIPLE	WAVE 300	435	18:00:00	WEEKDAY	WINTER	36.8
2	100	2	5	0		0	0	0	TRIPLE	WAVE 185	335	18:00:00	WEEKDAY	WINTER	164.5
2	2	12	317	0		0	0	0	TRIPLE	CU 0.25	395	18:00:00	WEEKDAY	WINTER	164.5
2	12	13	42	0		0	0	0	TRIPLE	CU 0.1	240	18:00:00	WEEKDAY	WINTER	108.9
2	13	14	88	0		0	0	0	TRIPLE	WAVE 95	235	03:00:00	WEEKDAY	WINTER	0
2	13	15	77	0		0	0	0	TRIPLE	CU 0.1	240	18:00:00	WEEKDAY	WINTER	100.3
2	15	16	32	0		0	0	0	TRIPLE	CU 0.1	240	18:00:00	WEEKDAY	WINTER	90

Figure 22 Example of Branch Results Report from Single Analysis without EGD

6.5 Voltage Results Tab

The Voltage Results report is shown in Figure 23 with EGD and Figure 24 without EGD. This report shows a row for each node in the model.

The first 6 columns of the Voltage Results report confirm the construction details for each node. The remaining columns of the report without EGD confirm the load flow results for each branch show the value of the lowest voltage received at that node and the time, day and season it was received. For the report with EGD, the load flow results for each branch show the value of the lowest and highest voltage received at that node and the time, day and season it was received together with any periods for which the voltage is outside of tolerance by amber/red bandings and phase

Note that the number of consumers and phasing count relate to consumers defined as being at a node. There can be multiple consumer types at a node, so the consumer type names are not shown.

Feeder Number	Node	Number Of Consumers	Phasing: Red	Phasing: Yellow	Phasing: Blue	Highest Voltage	Day of Highest Voltage	Season of Highest Voltage	Time of Highest Voltage	Lowest Voltage	Day of Lowest Voltage	Season of Lowest Voltage	Time of Lowest Voltage	Above Overvoltage Red Limit (Red Phase Hours)	Above Overvoltage Red Limit (Yellow Phase Hours)	Above Overvoltage Red Limit (Blue Phase Hours)	Within Overvoltage Amber Limit (Red Phase Hours)	Within Overvoltage Amber Limit (Yellow Phase Hours)	Within Overvoltage Amber Limit (Blue Phase Hours)	Within Nominal Green Band (Red Phase Hours)	Within Nominal Green Band (Yellow Phase Hours)	Within Nominal Green Band (Blue Phase Hours)	Within Undervoltage Amber Limit (Red Phase Hours)	Within Undervoltage Amber Limit (Yellow Phase Hours)	Within Undervoltage Amber Limit (Blue Phase Hours)	Beneath Undervoltage Red Limit (Red Phase Hours)	Beneath Undervoltage Red Limit (Yellow Phase Hours)	Beneath Undervoltage Red Limit (Blue Phase Hours)
1	1	0	0	0	0	230	WEEKDAY	WINTER	03:00:00	229.95	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0
1	11	0	0	0	0	229.57	WEEKDAY	WINTER	03:00:00	225.82	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0
1	101	36	12	12	12	229.57	WEEKDAY	WINTER	03:00:00	225.82	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0
1	102	7	2	3	2	229.57	WEEKDAY	WINTER	03:00:00	225.82	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0
2	2	0	0	0	0	229.98	WEEKDAY	WINTER	03:00:00	229.88	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0
2	12	0	0	0	0	228.98	WEEKDAY	WINTER	03:00:00	224.69	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0
2	13	0	0	0	0	228.75	WEEKDAY	WINTER	03:00:00	223.67	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0
2	14	0	0	0	0	228.75	WEEKDAY	WINTER	03:00:00	223.67	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0
2	15	0	0	0	0	228.38	WEEKDAY	WINTER	03:00:00	221.96	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0
2	16	0	0	0	0	228.25	WEEKDAY	WINTER	03:00:00	221.33	WEEKDAY	WINTER	18:00:00	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0

Figure 23 Example of Voltage Report from Single Analysis with EGD

Feeder Number	Node	Number Of Consumers	Phasing			Lowest Voltage	Day of Lowest Voltage	Season of Lowest Voltage	Time of Lowest Voltage
			Red	Yellow	Blue				
1	1	0	0	0	0	230	WEEKDAY	WINTER	18:00:00
1	11	0	0	0	0	223.33	WEEKDAY	WINTER	18:00:00
1	101	36	12	12	12	223.33	WEEKDAY	WINTER	18:00:00
1	102	7	2	3	2	223.33	WEEKDAY	WINTER	18:00:00
2	2	0	0	0	0	229.77	WEEKDAY	WINTER	18:00:00
2	12	0	0	0	0	222.64	WEEKDAY	WINTER	18:00:00
2	13	0	0	0	0	221.26	WEEKDAY	WINTER	18:00:00
2	14	0	0	0	0	221.26	WEEKDAY	WINTER	18:00:00
2	15	0	0	0	0	218.73	WEEKDAY	WINTER	18:00:00
2	16	0	0	0	0	217.81	WEEKDAY	WINTER	18:00:00

Figure 24 Example of Voltage Report from Single Analysis without EGD

7. Future Assessment

The Future Assessment function of the Network Model allows users to study the technical effect of a single growth scenario for one or more years. This function also allows users to study the effect of a capacity intervention against the effect of growth to see if it solves a capacity problem.

The future assessment tab (section 7.1) is used to configure the study and the results should be reviewed in either the Future Assessment results tab or the Future Interventions results tab that are described in 7.2.

7.1 Future Assessment Tab

The control panel for this assessment is shown in Figure 25.

Load Growth Rate (%)	0.00%
LCT Load Growth Probabilities	Custom
PV Take Up Rate	Low
HP Take Up Rate	Low
EV Take Up Rate	Medium
LCT Distribution Weighting	Even Distribution
Start Year	2020
End Year	2039
Winter Peak Only?	Yes
EV Charger size (VA)	7000
HP Size (Annual Consumption kWh)	4000
PV Size (kW)	3.5
Include EGD?	Yes
Run Type	Both
Intervention	Feeder Replacement
Select Feeder	2
New Cable Type	WAVE 600

Figure 25 Future Assessment modelling choices

The options that can be configured include:

- Background load growth rate (i.e. growth in consumption from non-low carbon technology devices).
- The set of LCT growth parameters as that should be used in the study, as discussed in section 3.2
- The LCT distribution weighting, where users can assign a set of assumptions regarding where on a feeder LCT should be connected in the study. Users have three options:
    - Evenly spread across existing customers along the feeder
    - Spread across existing customers on the first 50% of the feeder length.
    - Spread across existing customers on the second 50% of the feeder length

- The range of years that the study should cover by amending the start year and the end year fields.
- Winter Peak only, which declares whether to run the study under winter peak conditions for each year in the study or whether to complete a 365 day per year analysis of each year in the study
- The assumed size of a heat pump in the study, by annual consumption. (The daily load profile loaded into the study will then be scaled to reflect this size)
- The assumed size of an EV charger in the study (The daily load profile loaded into the study will then be scaled to reflect this size)
- The assumed size of a PV installation in the study (The daily load profile loaded into the study will then be scaled to reflect this size)
- Whether to run just DEBUT or DEBUT and EGD. If the study is run with DEBUT only, then the presence and growth, of photovoltaic generation will be disregarded.

In addition to analysis of the base case network, the performance of the network following any one of the following interventions can also be studied:

- SAVE interventions (community coaching, data-led engagement and low energy lightbulbs).
- In the case of studies using SAVE interventions, users will need to specify the year which they are to be applied.
- Transformer uprating. The new transformer rating must be selected.
- Overlaying a complete feeder with an alternative cable type. The new cable type and the feeder to be overlaid must be selected.
- Splitting a feeder to create two new feeders from the original single feeder. The new cable type and the node where the feeder split is required must be selected.

This report allows a technical analysis of the different interventions. An example of how the Network Model provides a summary of this comparison is shown in Figure 26 and Figure 27.

These summary tables describe for each feeder:

- The first year that a non-compliant voltage or loading condition is observed
- The maximum voltage drop on a feeder within the period
- The number of metres of a circuit that are overloaded

In this particular example, it can be seen how a feeder overlay resolves a voltage and current problem on feeder 4.

Results Summary

Last Run	19/07/2019 11:13
Debut Input Files	C:\SAVE\assessments\I_FUTURE_ASSESSMENT_2020_2019-07-19--11-13-31_*_*
Debut Output Files	C:\SAVE\assessments\O_FUTURE_ASSESSMENT_2020_2019-07-19--11-13-31_*_*

Substation	Max Tx Util (%)	Tx Hours Over Rating
Without intervention	236.8	184
With intervention	236.8	184

Without Intervention	Volt							Current Overload				
Feeder Number	Non Compliant Voltage First Year	Max Drop (%) Over Period	Max Rise(%) Over Period	Lower Red Over Period	Lower Amber Over Period	Upper Amber Over Period	Upper Red Over Period	Non Compliance Current First Year	Maximum Over Period (A)	Amber (m) Over Period	Red (m) Over Period	Longest (m) Over Period
1		5.8	0.1683	0	0	0	0		0	0	0	0
2	2030	15.3	0.0357	19	6	0	0	2035	54.4	42	5	47
3		2.6	0.1156	0	0	0	0		0	0	0	0
4	2027	18.2	0.3040	5	8	0	0	2027	457.5	0	444	281
5		1.3	0.1493	0	0	0	0		0	0	0	0
6		5.6	0.0775	0	0	0	0		26.7	52	0	52

With Intervention	Volt							Current Overload				
Feeder Number	Non Compliant Voltage First Year	Max Drop (%) Over Period	Max Rise(%) Over Period	Lower Red Over Period	Lower Amber Over Period	Upper Amber Over Period	Upper Red Over Period	Non Compliance Current First Year	Maximum Over Period (A)	Amber (m) Over Period	Red (m) Over Period	Longest (m) Over Period
1		5.8	0.1683	0	0	0	0		0	0	0	0
2		5.1	0.2331	0	0	0	0		0	0	0	0
3		2.6	0.1156	0	0	0	0		0	0	0	0
4	2027	18.2	0.3040	5	8	0	0	2027	457.5	0	444	281
5		1.3	0.1493	0	0	0	0		0	0	0	0
6		5.6	0.0775	0	0	0	0		26.7	52	0	52

Figure 26 Comparison of intervention in Future Assessment with EGD

Results Summary

Last Run	25/06/2019 10:31
Debut Input Files	C:\SAVE\assessments\I_FUTURE_ASSESSMENT_2020_2019-06-25--10-31-49_*_*
Debut Output Files	C:\SAVE\assessments\O_FUTURE_ASSESSMENT_2020_2019-06-25--10-31-49_*_*

Substation	Max Tx Util (%)	Tx Hours Over Rating
Without intervention	236.8	184
With intervention	236.8	184

Without Intervention	Volt				Current Overload				
Feeder Number	Non Compliant Voltage First Year	Max Drop (%) Over Period	Lower Red Over Period	Lower Amber Over Period	Non Compliance Current First Year	Maximum Over Period (A)	Amber (m) Over Period	Red (m) Over Period	Longest (m) Over Period
1		5.8	0	0		0	0	0	0
2	2030	15.3	136	85	2035	54.4	215	25	47
3		2.6	0	0		0	0	0	0
4	2027	18.2	50	61	2027	457.5	932	1818	281
5		1.3	0	0		0	0	0	0
6		5.6	0	0		26.7	211	0	52

With Intervention	Volt				Current Overload				
Feeder Number	Non Compliant Voltage First Year	Max Drop (%) Over Period	Lower Red Over Period	Lower Amber Over Period	Non Compliance Current First Year	Maximum Over Period (A)	Amber (m) Over Period	Red (m) Over Period	Longest (m) Over Period
1		5.8	0	0		0	0	0	0
2	2030	15.3	136	85	2035	54.4	215	25	47
3		2.6	0	0		0	0	0	0
4		5.2	0	0		0	0	0	0
5		1.3	0	0		0	0	0	0
6		5.6	0	0		26.7	211	0	52

Figure 27 Comparison of intervention in Future Assessment without EGD

The detailed reports can be found under the worksheets labelled as Future Assessment Results and Future Intervention Results, as shown in Figure 28, Figure 29, Figure 30 and Figure 31.

7.2 Future Assessment Tab and Future Interventions Tab

The full output from the future assessment, either with or without interventions are published on the tabs known as:

- Future Assessment, describing any network issues observed, but without the effect of any interventions specified to be tested. The results tables for a Future assessment are depicted in Figure 28 for using the DEBUT engine alone or Figure 29 if the EGD and DEBUT engines were enabled.
- Future Intervention results, describing any network issues observed, but after the effect of any interventions specified to be tested. The results tables for a Future interventions assessment are depicted in Figure 30 for using the DEBUT engine alone or Figure 31 if the EGD and DEBUT engines were enabled.

By comparing these reports, users can firstly assess whether a particular growth trend causes network compliance problems and then progress onto assessing whether a particular intervention can remove the network compliance issues.

Future Assessment Results (No Intervention)

Year	Voltage										Thermal									
	Max Volt Drop					Max Volt Rise					Max Cable Utilisation						Max Transformer Utilisation			
	Volt Drop (%)	Volt Drop Node	Volt Drop Time	Volt Drop Day	Volt Drop Season	Volt Rise (%)	Volt Rise Node	Volt Rise Time	Volt Rise Day	Volt Rise Season	Max Utilisation (%)	Near Node	Far Node	Cable Utilisation Time	Cable Utilisation Day	Cable Utilisation Season	Max Tx Utilisation (%)	Tx Utilisation Time	Tx Utilisation Day	Tx Utilisation Season
2020	8.5	50	18:00:00	WEEKDAY	WINTER	0	100	00:30:00	WEEKDAY	WINTER	91.9	100	4	18:00:00	WEEKDAY	WINTER	91.44	18:00:00	WEEKDAY	WINTER
2021	8.6	50	18:00:00	WEEKDAY	WINTER	0	100	00:30:00	WEEKDAY	WINTER	94	100	4	18:00:00	WEEKDAY	WINTER	91.78	18:00:00	WEEKDAY	WINTER
2022	9.7	51	18:00:00	WEEKDAY	WINTER	0.06	168	03:00:00	WEEKDAY	WINTER	95.2	100	4	18:00:00	WEEKDAY	WINTER	94.84	18:00:00	WEEKDAY	WINTER
2023	9.8	51	18:00:00	WEEKDAY	WINTER	0.05	168	03:00:00	WEEKDAY	WINTER	97	100	4	18:00:00	WEEKDAY	WINTER	95.5	18:00:00	WEEKDAY	WINTER
2024	9.8	50	18:00:00	WEEKDAY	WINTER	0.05	168	03:00:00	WEEKDAY	WINTER	100	100	4	18:00:00	WEEKDAY	WINTER	96.34	18:00:00	WEEKDAY	WINTER
2025	8.6	50	18:30:00	WEEKDAY	WINTER	0.04	150	17:30:00	WEEKDAY	WINTER	98.7	100	4	18:00:00	WEEKDAY	WINTER	97.92	18:00:00	WEEKDAY	WINTER
2026	8.9	51	18:30:00	WEEKDAY	WINTER	0.04	150	17:30:00	WEEKDAY	WINTER	103	100	4	18:30:00	WEEKDAY	WINTER	101.72	21:00:00	WEEKDAY	WINTER
2027	10	51	18:00:00	WEEKDAY	WINTER	0.12	116	17:30:00	WEEKDAY	WINTER	112	100	4	21:00:00	WEEKDAY	WINTER	110.98	21:00:00	WEEKDAY	WINTER
2028	10.9	50	21:00:00	WEEKDAY	WINTER	0.17	102	03:00:00	WEEKDAY	WINTER	123	100	4	21:00:00	WEEKDAY	WINTER	121.22	21:00:00	WEEKDAY	WINTER
2029	11.7	50	21:00:00	WEEKDAY	WINTER	0.11	118	03:00:00	WEEKDAY	WINTER	136	100	4	21:00:00	WEEKDAY	WINTER	134.42	21:00:00	WEEKDAY	WINTER
2030	12.5	50	21:00:00	WEEKDAY	WINTER	0.11	117	03:00:00	WEEKDAY	WINTER	150	100	4	21:00:00	WEEKDAY	WINTER	148.86	21:00:00	WEEKDAY	WINTER
2031	12.6	50	21:00:00	WEEKDAY	WINTER	0.1	150	03:00:00	WEEKDAY	WINTER	166	100	4	21:00:00	WEEKDAY	WINTER	164.06	21:00:00	WEEKDAY	WINTER
2032	14.6	50	21:00:00	WEEKDAY	WINTER	0.3	139	03:00:00	WEEKDAY	WINTER	183	100	4	21:00:00	WEEKDAY	WINTER	176.92	21:30:00	WEEKDAY	WINTER
2033	15.7	50	21:00:00	WEEKDAY	WINTER	0.15	152	16:00:00	WEEKDAY	WINTER	193	100	4	21:00:00	WEEKDAY	WINTER	190.82	21:30:00	WEEKDAY	WINTER
2034	16.4	51	21:00:00	WEEKDAY	WINTER	0.16	102	03:00:00	WEEKDAY	WINTER	215	100	4	21:30:00	WEEKDAY	WINTER	211.4	21:30:00	WEEKDAY	WINTER
2035	18	50	21:00:00	WEEKDAY	WINTER	0.11	152	03:00:00	WEEKDAY	WINTER	236	100	4	21:30:00	WEEKDAY	WINTER	235.32	21:30:00	WEEKDAY	WINTER
2036	18	50	21:00:00	WEEKDAY	WINTER	0.11	152	03:00:00	WEEKDAY	WINTER	236	100	4	21:30:00	WEEKDAY	WINTER	236.3	21:30:00	WEEKDAY	WINTER
2037	18	50	21:00:00	WEEKDAY	WINTER	0.11	152	03:00:00	WEEKDAY	WINTER	236	100	4	21:30:00	WEEKDAY	WINTER	236.3	21:30:00	WEEKDAY	WINTER
2038	18.2	51	21:00:00	WEEKDAY	WINTER	0.11	152	03:00:00	WEEKDAY	WINTER	237	100	4	21:30:00	WEEKDAY	WINTER	236.8	21:30:00	WEEKDAY	WINTER
2039	18.2	51	21:00:00	WEEKDAY	WINTER	0.11	152	03:00:00	WEEKDAY	WINTER	237	100	4	21:30:00	WEEKDAY	WINTER	236.8	21:30:00	WEEKDAY	WINTER

Figure 28 Future Assessment full results without EGD

Future Assessment Results (No Intervention)

Year	Voltage					Thermal									
	Max Volt Drop					Max Cable Utilisation						Max Transformer Utilisation			
	Volt Drop (%)	Volt Drop Node	Volt Drop Time	Volt Drop Day	Volt Drop Season	Max Utilisation (%)	Near Node	Far Node	Cable Utilisation Time	Cable Utilisation Day	Cable Utilisation Season	Max Tx Utilisation (%)	Tx Utilisation Time	Tx Utilisation Day	Tx Utilisation Season
2020	8.5	50	18:00:00	WEEKDAY	WINTER	91.9	100	4	18:00:00	WEEKDAY	WINTER	91.44	18:00:00	WEEKDAY	WINTER
2021	8.6	50	18:00:00	WEEKDAY	WINTER	94	100	4	18:00:00	WEEKDAY	WINTER	91.78	18:00:00	WEEKDAY	WINTER
2022	9.7	51	18:00:00	WEEKDAY	WINTER	95.2	100	4	18:00:00	WEEKDAY	WINTER	94.84	18:00:00	WEEKDAY	WINTER
2023	9.8	51	18:00:00	WEEKDAY	WINTER	97	100	4	18:00:00	WEEKDAY	WINTER	95.5	18:00:00	WEEKDAY	WINTER
2024	9.8	50	18:00:00	WEEKDAY	WINTER	100	100	4	18:00:00	WEEKDAY	WINTER	96.34	18:00:00	WEEKDAY	WINTER
2025	8.6	50	18:30:00	WEEKDAY	WINTER	98.7	100	4	18:00:00	WEEKDAY	WINTER	97.92	18:00:00	WEEKDAY	WINTER
2026	8.9	51	18:30:00	WEEKDAY	WINTER	103	100	4	18:30:00	WEEKDAY	WINTER	101.72	21:00:00	WEEKDAY	WINTER
2027	10	51	18:00:00	WEEKDAY	WINTER	112	100	4	21:00:00	WEEKDAY	WINTER	110.98	21:00:00	WEEKDAY	WINTER
2028	10.9	50	21:00:00	WEEKDAY	WINTER	123	100	4	21:00:00	WEEKDAY	WINTER	121.22	21:00:00	WEEKDAY	WINTER
2029	11.7	50	21:00:00	WEEKDAY	WINTER	136	100	4	21:00:00	WEEKDAY	WINTER	134.42	21:00:00	WEEKDAY	WINTER
2030	12.5	50	21:00:00	WEEKDAY	WINTER	150	100	4	21:00:00	WEEKDAY	WINTER	148.86	21:00:00	WEEKDAY	WINTER
2031	12.6	50	21:00:00	WEEKDAY	WINTER	166	100	4	21:00:00	WEEKDAY	WINTER	164.06	21:00:00	WEEKDAY	WINTER
2032	14.6	50	21:00:00	WEEKDAY	WINTER	183	100	4	21:00:00	WEEKDAY	WINTER	176.92	21:30:00	WEEKDAY	WINTER
2033	15.7	50	21:00:00	WEEKDAY	WINTER	193	100	4	21:00:00	WEEKDAY	WINTER	190.82	21:30:00	WEEKDAY	WINTER
2034	16.4	51	21:00:00	WEEKDAY	WINTER	215	100	4	21:30:00	WEEKDAY	WINTER	211.4	21:30:00	WEEKDAY	WINTER
2035	18	50	21:00:00	WEEKDAY	WINTER	236	100	4	21:30:00	WEEKDAY	WINTER	235.32	21:30:00	WEEKDAY	WINTER
2036	18	50	21:00:00	WEEKDAY	WINTER	236	100	4	21:30:00	WEEKDAY	WINTER	236.3	21:30:00	WEEKDAY	WINTER
2037	18	50	21:00:00	WEEKDAY	WINTER	236	100	4	21:30:00	WEEKDAY	WINTER	236.3	21:30:00	WEEKDAY	WINTER
2038	18.2	51	21:00:00	WEEKDAY	WINTER	237	100	4	21:30:00	WEEKDAY	WINTER	236.8	21:30:00	WEEKDAY	WINTER
2039	18.2	51	21:00:00	WEEKDAY	WINTER	237	100	4	21:30:00	WEEKDAY	WINTER	236.8	21:30:00	WEEKDAY	WINTER

Figure 29 Future Assessment full results with EGD

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Future Assessment Results (Feeder Replacement)

	Voltage										Thermal									
	Max Volt Drop					Max Volt Rise					Max Cable Utilisation						Max Transformer Utilisation			
Year	Volt Drop (%)	Volt Drop Node	Volt Drop Time	Volt Drop Day	Volt Drop Season	Volt Rise (%)	Volt Rise Node	Volt Rise Time	Volt Rise Day	Volt Rise Season	Max Utilisation (%)	Near Node	Far Node	Cable Utilisation Time	Cable Utilisation Day	Cable Utilisation Season	Max Tx Utilisation (%)	Tx Utilisation Time	Tx Utilisation Day	Tx Utilisation Season
2020	8.5	50	18:00:00	WEEKDAY	WINTER	0	100	00:30:00	WEEKDAY	WINTER	91.9	100	4	18:00:00	WEEKDAY	WINTER	91.44	18:00:00	WEEKDAY	WINTER
2021	8.6	50	18:00:00	WEEKDAY	WINTER	0	100	00:30:00	WEEKDAY	WINTER	94	100	4	18:00:00	WEEKDAY	WINTER	91.78	18:00:00	WEEKDAY	WINTER
2022	9.7	51	18:00:00	WEEKDAY	WINTER	0.06	168	03:00:00	WEEKDAY	WINTER	95.2	100	4	18:00:00	WEEKDAY	WINTER	94.84	18:00:00	WEEKDAY	WINTER
2023	9.8	51	18:00:00	WEEKDAY	WINTER	0.05	168	03:00:00	WEEKDAY	WINTER	97	100	4	18:00:00	WEEKDAY	WINTER	95.5	18:00:00	WEEKDAY	WINTER
2024	9.8	50	18:00:00	WEEKDAY	WINTER	0.05	168	03:00:00	WEEKDAY	WINTER	100	100	4	18:00:00	WEEKDAY	WINTER	96.34	18:00:00	WEEKDAY	WINTER
2025	8.6	50	18:30:00	WEEKDAY	WINTER	0.04	150	17:30:00	WEEKDAY	WINTER	98.7	100	4	18:00:00	WEEKDAY	WINTER	97.92	18:00:00	WEEKDAY	WINTER
2026	8.9	51	18:30:00	WEEKDAY	WINTER	0.04	150	17:30:00	WEEKDAY	WINTER	103	100	4	18:30:00	WEEKDAY	WINTER	101.72	21:00:00	WEEKDAY	WINTER
2027	10	51	18:00:00	WEEKDAY	WINTER	0.12	116	17:30:00	WEEKDAY	WINTER	112	100	4	21:00:00	WEEKDAY	WINTER	110.98	21:00:00	WEEKDAY	WINTER
2028	10.9	50	21:00:00	WEEKDAY	WINTER	0.17	102	03:00:00	WEEKDAY	WINTER	123	100	4	21:00:00	WEEKDAY	WINTER	121.22	21:00:00	WEEKDAY	WINTER
2029	11.7	50	21:00:00	WEEKDAY	WINTER	0.11	118	03:00:00	WEEKDAY	WINTER	136	100	4	21:00:00	WEEKDAY	WINTER	134.42	21:00:00	WEEKDAY	WINTER
2030	12.5	50	21:00:00	WEEKDAY	WINTER	0.11	117	03:00:00	WEEKDAY	WINTER	150	100	4	21:00:00	WEEKDAY	WINTER	148.86	21:00:00	WEEKDAY	WINTER
2031	12.6	50	21:00:00	WEEKDAY	WINTER	0.1	150	03:00:00	WEEKDAY	WINTER	166	100	4	21:00:00	WEEKDAY	WINTER	164.06	21:00:00	WEEKDAY	WINTER
2032	14.6	50	21:00:00	WEEKDAY	WINTER	0.3	139	03:00:00	WEEKDAY	WINTER	183	100	4	21:00:00	WEEKDAY	WINTER	176.92	21:30:00	WEEKDAY	WINTER
2033	15.7	50	21:00:00	WEEKDAY	WINTER	0.15	152	16:00:00	WEEKDAY	WINTER	193	100	4	21:00:00	WEEKDAY	WINTER	190.82	21:30:00	WEEKDAY	WINTER
2034	16.4	51	21:00:00	WEEKDAY	WINTER	0.16	102	03:00:00	WEEKDAY	WINTER	215	100	4	21:30:00	WEEKDAY	WINTER	211.4	21:30:00	WEEKDAY	WINTER
2035	18	50	21:00:00	WEEKDAY	WINTER	0.23	113	03:00:00	WEEKDAY	WINTER	236	100	4	21:30:00	WEEKDAY	WINTER	235.32	21:30:00	WEEKDAY	WINTER
2036	18	50	21:00:00	WEEKDAY	WINTER	0.23	113	03:00:00	WEEKDAY	WINTER	236	100	4	21:30:00	WEEKDAY	WINTER	236.3	21:30:00	WEEKDAY	WINTER
2037	18	50	21:00:00	WEEKDAY	WINTER	0.23	113	03:00:00	WEEKDAY	WINTER	236	100	4	21:30:00	WEEKDAY	WINTER	236.3	21:30:00	WEEKDAY	WINTER
2038	18.2	51	21:00:00	WEEKDAY	WINTER	0.23	113	03:00:00	WEEKDAY	WINTER	237	100	4	21:30:00	WEEKDAY	WINTER	236.8	21:30:00	WEEKDAY	WINTER
2039	18.2	51	21:00:00	WEEKDAY	WINTER	0.23	113	03:00:00	WEEKDAY	WINTER	237	100	4	21:30:00	WEEKDAY	WINTER	236.8	21:30:00	WEEKDAY	WINTER

Figure 30 Future Intervention full results without EGD

Future Assessment Results (Feeder Replacement)

	Voltage					Thermal									
	Max Volt Drop					Max Cable Utilisation						Max Transformer Utilisation			
Year	Volt Drop (%)	Volt Drop Node	Volt Drop Time	Volt Drop Day	Volt Drop Season	Max Utilisation (%)	Near Node	Far Node	Cable Utilisation Time	Cable Utilisation Day	Cable Utilisation Season	Max Tx Utilisation (%)	Tx Utilisation Time	Tx Utilisation Day	Tx Utilisation Season
2020	6.9	28	18:00:00	WEEKDAY	WINTER	51.3	100	2	18:00:00	WEEKDAY	WINTER	91.44	18:00:00	WEEKDAY	WINTER
2021	6.9	28	18:00:00	WEEKDAY	WINTER	51.3	100	2	18:00:00	WEEKDAY	WINTER	91.78	18:00:00	WEEKDAY	WINTER
2022	7.2	27	18:00:00	WEEKDAY	WINTER	52.8	100	2	18:00:00	WEEKDAY	WINTER	94.84	18:00:00	WEEKDAY	WINTER
2023	7.2	28	18:00:00	WEEKDAY	WINTER	53.5	100	2	18:00:00	WEEKDAY	WINTER	95.5	18:00:00	WEEKDAY	WINTER
2024	7.5	28	18:00:00	WEEKDAY	WINTER	55	100	2	18:00:00	WEEKDAY	WINTER	96.34	18:00:00	WEEKDAY	WINTER
2025	7.1	25	21:00:00	WEEKDAY	WINTER	53.8	100	2	18:00:00	WEEKDAY	WINTER	97.92	18:00:00	WEEKDAY	WINTER
2026	7.3	27	21:00:00	WEEKDAY	WINTER	55.7	100	2	18:00:00	WEEKDAY	WINTER	101.72	21:00:00	WEEKDAY	WINTER
2027	9.3	28	18:00:00	WEEKDAY	WINTER	60.3	100	2	21:00:00	WEEKDAY	WINTER	110.98	21:00:00	WEEKDAY	WINTER
2028	9.2	28	18:00:00	WEEKDAY	WINTER	64.5	100	2	21:00:00	WEEKDAY	WINTER	121.22	21:00:00	WEEKDAY	WINTER
2029	9.6	28	21:00:00	WEEKDAY	WINTER	68.7	100	2	21:00:00	WEEKDAY	WINTER	134.42	21:00:00	WEEKDAY	WINTER
2030	10.4	28	21:00:00	WEEKDAY	WINTER	77.5	100	2	21:00:00	WEEKDAY	WINTER	148.86	21:00:00	WEEKDAY	WINTER
2031	11.3	28	21:00:00	WEEKDAY	WINTER	84.8	100	2	21:00:00	WEEKDAY	WINTER	164.06	21:00:00	WEEKDAY	WINTER
2032	11.9	112	21:00:00	WEEKDAY	WINTER	90	100	2	21:00:00	WEEKDAY	WINTER	176.92	21:30:00	WEEKDAY	WINTER
2033	12.1	27	21:00:00	WEEKDAY	WINTER	93.7	100	2	21:00:00	WEEKDAY	WINTER	190.82	21:30:00	WEEKDAY	WINTER
2034	14.3	28	21:00:00	WEEKDAY	WINTER	106	100	2	21:00:00	WEEKDAY	WINTER	211.4	21:30:00	WEEKDAY	WINTER
2035	15.3	28	21:00:00	WEEKDAY	WINTER	116	100	2	21:00:00	WEEKDAY	WINTER	235.32	21:30:00	WEEKDAY	WINTER
2036	15.3	28	21:00:00	WEEKDAY	WINTER	116	100	2	21:00:00	WEEKDAY	WINTER	236.3	21:30:00	WEEKDAY	WINTER
2037	15.3	28	21:00:00	WEEKDAY	WINTER	116	100	2	21:00:00	WEEKDAY	WINTER	236.3	21:30:00	WEEKDAY	WINTER
2038	15.3	28	21:00:00	WEEKDAY	WINTER	116	100	2	21:00:00	WEEKDAY	WINTER	236.8	21:30:00	WEEKDAY	WINTER
2039	15.3	28	21:00:00	WEEKDAY	WINTER	116	100	2	21:00:00	WEEKDAY	WINTER	236.8	21:30:00	WEEKDAY	WINTER

Figure 31 Future Intervention full results without EGD

7.2.1 Branch and Voltage Results Tabs

The user will be familiar with the Branch results tab and voltage results tab associated with the single assessment. To enable users to understand a more detailed vision of the network, these tabs are populated with the final year in the study's results from the network analysis.

8. Multi Scenario costing assessment

The purpose of this report is to understand the best way to manage an LV secondary network across different growth scenarios, by investigating which capacity interventions should be selected when, and what is the cheapest or least risk approach to take.

The LV multi-scenario analysis is supported by 6 worksheets within the overall module.

Recognising that it can be problematic to commit to a single growth forecast, the LV multi-scenario environment allows up to four growth scenarios to be studied. A design choice was made to limit the number of scenarios that could be studied simultaneously to avoid excessive computation time.

The Multi-Scenario analysis reports thermal issues observed on feeders but does not consider voltage issues within its economic decision-making process. Users may choose to use the only DEBUT if they wish to consider the effect of growth in electrical consumption only. If users wish to explore the effect of growth in electrical consumption and PV generation simultaneously, then the analysis will need to be undertaken using EGD and DEBUT. Because of the limitations of iterative load flow calculation methodology, users may expect networks to stop converging under conditions of high network loading. Users will need to take this into account when they are planning their network studies.

When an assessment is conducted, the process described in section 8.1 is undertaken. The process may be initiated through the tab described in 8.4 and sections 8.5 and 8.6 describe how the results may be reviewed.

8.1 Process Methodology

8.1.1 Investment Strategies

To simulate the effect of different investment approaches the tool can be used to investigate the effect of different approaches to spending money on capacity problems. Each strategy is equipped to be able to use items from a common list of capacity interventions in a slightly different approach. The description of the capacity interventions available can be found in

All-Knowing

The All-Knowing strategy represents a strategy which considers the use of the following interventions:

- Overlay of an LV feeder branch
- Feeder splitting
- Transformer uprating
- Low energy lightbulbs
- Data led engagement
- Community coaching
- Price signals

The All-Knowing strategy recommends the intervention sequence that gives the minimum cost works to deliver sufficient capacity at the selected end year and instigates that scheme in the year of the first observed overload on a feeder or transformer.

The cheapest solution or sequence is identified by firstly understanding whether the network becomes overloaded in the study and then by identifying the first year in which branches become overloaded.

Each possible intervention is then tested to see if it creates sufficient new capacity to last until the end of the planning horizon. Where a single physical intervention is not sufficient, it may be paired with additional interventions to provide a compliant solution. The cheapest solutions set is then isolated as the minimum cost scheme.

Once the capital intervention step has been undertaken, each of the SAVE interventions models are tested to see if they are able to resolve overloads, and for how many years they can defer LV reinforcements. This is achieved by modelling each SAVE intervention in the Network Model. The effect of the SAVE interventions is modelled by using the customer profiles and intervention profiles to change each customer profile and then re-running the Network Model.

The number of years that a SAVE intervention can mitigate overloads across the entire substation is then noted. The annual cost of SAVE interventions is then assessed to be the cost of the SAVE intervention divided by the number of years of deferred reinforcements that it delivers.

The economic test of whether a SAVE intervention creates value is to assess whether the annual cost of a SAVE intervention is less than the interest earnt on the net present value of the capital intervention strategy. The interest rate used for this calculation is as per the value specified in Figure 34.

Where SAVE interventions are shown to be economic, they are instigated across the secondary substation in the year of the first observed overload, to defer the planning capital interventions. Subsequent capital interventions are then triggered in the year that load growth overtakes the effect of the SAVE interventions. Once a SAVE intervention alone is not able to defer a physical intervention, then it is removed from the study and the best economically physical intervention available is selected.

The approach to the cost of each individual intervention is recorded in Appendix I.

It should be noted that SAVE interventions are not expected to resolve spring, summer or autumn import overloads or any overloads driven by export. For this reason, SAVE interventions are automatically discounted from resolving these issues. This approach also considers that the minimum deployment resolution of SAVE interventions is one secondary substation and that one SAVE intervention may be used to defer a reinforcement rather than stacked SAVE interventions.

Flexibility Minimum

The Flexibility Minimum strategy represents a strategy which considers the use of the following interventions:

- Incremental overlay of an LV feeder branch
- Feeder splitting
- Transformer uprating

This strategy is analogous to the traditional approach to network management where only network led solutions are available.

This strategy calculates an abutting sequence of capacity interventions to span up to the study end date but makes use of a concept known as the network design date.

The network design date concept replicates good investment practice by seeking to resolve as many network problems into one intervention to avoid repeated visits to uprate different parts of a feeder over time.

By specifying a network design date which is in the near future, the model resolves all overloads observed up to the network design date in the year of the first overload and then takes an incremental approach to resolve overloads after the network design date. As in the All-Knowing strategy, all required interventions for a feeder or for a transformer are to be undertaken in one year.

Use of the network design date allows the user to strike a balance between the risk of stranding assets against the wasted cost of sequential mobilisations, for reinforcement projects on the same feeder. The network design date will have a bearing on what strategy is undertaken. For example, where a feeder split is required for one network design year, moving to an earlier design date may change the strategy to one where overlays are implemented instead.

The cheapest intervention sequence is resolved by firstly understanding whether the network becomes overloaded without any interventions and when.

Each possible intervention is then tested to see if it creates sufficient new capacity to last until the network design date which has been specified by the user. If a split and an overlay are possible interventions (in that they provide sufficient capacity), the cost of each intervention is calculated to determine which is cheaper and thus preferred.

The minimum intervention to meet the network design date is then added to the Network Model and the years between the network design date and the end of the planning horizon are studied to detect in which years new and additional overloads occur. Each new overload is then mitigated with the minimum cost capital scheme and the year in which it was required is recorded. After the network design date, only incremental overlays are considered for feeders (and not feeder splitting).

The approach to the cost of each individual intervention is recorded in Appendix I.

Flexibility Maximum

The Flexibility Maximum strategy represents a strategy which considers the use of the following interventions:

- Incremental overlay of an LV feeder branch
- Feeder splitting
- Transformer uprating
- Data led engagement
- Community Coaching
- Transformer uprating
- Price Signals

This strategy follows the traditional approach to network management insofar as capacity intervention schemes are only required to create capacity within a credible investment horizon (known as the network design date), but also assesses the cost of capacity interventions to the end of the planning study.

Unlike Flexibility Minimum, this strategy allows non-network solutions to be used which allows further optionality value to be explored. This strategy using the same approach to the calculation of an abutting sequence of interventions as Flexibility Minimum but with the assumption that SAVE interventions are only deployed ahead of capital interventions and also with the same assumptions regarding the application of SAVE interventions as the All-Knowing strategy.

Once the capital intervention step has been identified, each of the SAVE intervention models is tested to see if they are able to resolve overloads and for how many years they can defer LV reinforcements.

This is done by modelling each SAVE intervention within the Network Model. The effect of the SAVE interventions is modelled by using the customer profiles and intervention profiles to change each customer profile and then re-running the Network Model. The number of years that a SAVE intervention can mitigate overloads across the entire substation for is then noted. The annual cost of SAVE interventions is then assessed to be the cost of the SAVE intervention divided by the number of years of deferred reinforcements that it delivers.

Low energy lightbulbs, community coaching and data-led engagement are tested for as many years as they are viable. In the case of Price Signals, these are tested for a three-year period and a cost is determined. If they can provide sufficient downturn, then the next three-year block (with its associated Price Signal) is considered. This process is repeated until the Price Signal required exceeds the maximum value in the ‘Incentive Below’ table or the Price Signal fails the economic test.

The economic test of whether a SAVE intervention creates value is to assess whether the annual cost of a SAVE intervention is less than the interest earnt on the net present value of the capital intervention strategy. The interest rate used for this calculation is as per the value specified in Figure 34.

Where SAVE interventions are shown to be economic then they are instigated across the secondary substation in the year of the first observed overload to defer the planned capital interventions. Subsequent capital interventions are then triggered in the year that load growth overtakes the effect of the SAVE interventions

All-Knowing will report the same intervention strategy as Flexibility Maximum where the Network Design Date is the same as the study End Year. The Flexibility Minimum will report the same intervention strategy as Flexibility Maximum where no SAVE Interventions are sufficient and cost-effective.

For each individual study that is run, the consumer profile is amended as follows

- SAVE intervention profile for the selected consumer profile with an allowance for any erosion factor;
- Annual Consumption with the annual growth applied (and compounded) for the year for which the study is undertaken; and
- EV and HP take up based on the scenario type (BEIS or Custom) and the year for which the study is undertaken.

8.2 Process Flow

The overall process seeks to decide what is the cheapest approach to investment using different sets of investment rules. These investment rules are referred to as strategies. Figure 32 describes the overall process flow for this part of the tool that is applied to each growth scenario study.

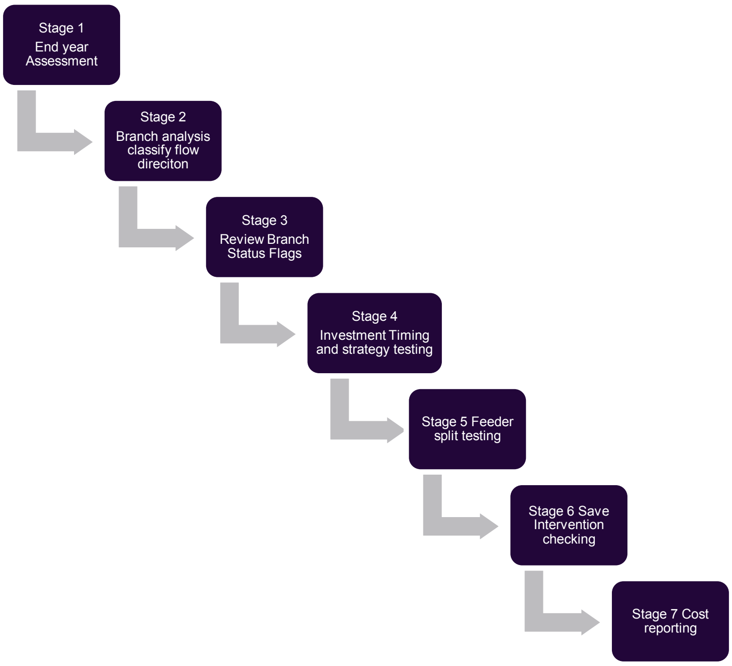

Figure 32 Multi-Scenario process flow

Stage 1 - End Year Assessment

The first action is to determine what interventions are required to reach the study end year. The following statuses will cause a report and termination of the process for a scenario: -

- no intervention is required by the end year;
- no transformer upgrade that has a sufficiently large capacity to meet the requirements for the end year; and
- an error is reported in the DEBUT or EGD engine.

This part of the process will use either DEBUT or DEBUT and EGD depending on the user's study run preferences.

Stage 2 – Branch analysis and flow direction

If EGD has been allowed to run, then the study will need to classify each branch overload according to whether it is an import or export overload. using the following logic.

- If the Maximum current upstream > Maximum current downstream – classify as export overload
- If Maximum current upstream < Maximum current downstream – classify as import
- If Maximum current upstream = Maximum Current downstream AND Maximum current >0 classify as an import.

If the user has only allowed the study to use DEBUT, then all overloads are automatically calculated as imports.

This part of the process returns to the process a flag for each branch that is expected to exceed its rating within the study period and whether it is an import or export overload.

Stage 3 – Review Branch Status Flags

For each of the overloads flagged in stage 2, the process determines the recommended cable size for a simple cable overlay scheme for each branch and the cost to implement the overlay based on the cost assumptions set by the user.

The output from this process will be based on the expected overloads from DEBUT. (Note: recommended cable size now based on the biggest of Maximum Current Upstream (EGD), Maximum Current Downstream (EGD) or Maximum Current (DEBUT), where EGD is run) If the user has enabled the study to use DEBUT and EGD, then for any branches of the feeder which only experience an export overload will be costed on the basis of the EGD results. Any branches which experience an import and export overloads will be costed on the basis of the DEBUT results using the cheaper of split or overlay using the recommended cable size.

Stage 4 - Investment Timing and strategy testing

The process will then seek to find the cheapest approach in Net Present Cost terms (note: comparing the three strategies (All-Knowing, Flex Max, Flex Min) gives net present costs of each, which can be compared – NPC is only shown at the end and to determine which of a number of viable SAVE interventions should be selected) to navigate from the start year to the end year of the study, using the rules set by each investment strategy. In this stage, the process is limited to feeder overlay solutions only. (Note: Where an overlay or split option are available it will determine the cheaper. It will also calculate whether a viable SAVE intervention is financially beneficial in deferring a physical intervention – for import overloads.)

Each of the three strategies follows a similar process to determine what interventions (if any) are required and when they should be applied. For each strategy, the actions required are identified and the Costing Output is populated.

Once any actions that have been identified have been applied to the study, the next step is to determine when the next intervention is required.

For speed purposes, this is done using a binary chop strategy (i.e. run a study for the year midway between the start year and the end year). If the intervention is required before the midway year, split the period between the start year and midway year in a half. If the intervention is required after the midway, split the period between the midway year and the end year. Run a study for the new midpoint year and repeat. By the end of this process, the year when the intervention is required will have been established and what intervention is required per branch.

Stage 5 - Feeder Split Assessment

The next step is to determine the cost of resolving feeder capacity issues by using a feeder split methodology in comparison to an incremental feeder overlay approach. For the All-Knowing strategy, the end year is used; for the Flexibility Minimum and Flexibility Maximum, the network design year is used. The feeder split strategy is to find the point in the feeder tree where half the number of consumers (irrespective of consumption) are allocated to the current and the new feeder. If an exact numerical split cannot be found, the nearest to a 50/50 split is found. If more than one node could be selected to satisfy a 50/50 split (or the nearest to a 50/50 split), then the one with the shortest distance from the substation is selected.

The cost of the feeder splitting scheme is then calculated on the basis of the assumption that the new cable follows the route of the existing cable but is only of a length required to reach the point of the 50/50 customer split. (Note: after a feeder split has been determined, there is a further check to determine if any additional overlays are required – these are included in the cost calculation.)

Feeder splits will be selected by the process when there are no longer cables sufficiently large to resolve the original overload using overlays or when the net cost of a feeder split is cheaper in net present terms than an incremental overlay over time.

Stage 6 - SAVE Intervention Checking

This section will only be actioned if all three of the following circumstances apply:

- The strategy being evaluated is the All-Knowing or Flexibility Maximum strategy;
- No intervention actions have already been identified – i.e. first time through; and
- The intervention required is to resolve a feeder import overload.

The first step is to determine how long each of the SAVE interventions can defer a physical intervention.

For the Price Signal SAVE intervention, the requirement is that the Price Signal must work for a period of 3 years and that it cannot exceed the maximum value in the 'Incentive Below' list. Price Signal tests are repeated (for 3-year periods) until a physical intervention is required, the 'Incentive Below' maximum value is exceeded or the study end year is reached. Price signals will only be selected when the overload is located on the first section of cable out from the substation or the transformer and there are no other overloads located on the feeder.

For the other SAVE interventions. They are tested and the year in which a physical intervention would be needed (or the study end year is reached) is determined.

If any SAVE interventions found to be effective, a calculation is undertaken to test if the interest that can be earnt by deferring the most immediate physical intervention is more than the SAVE intervention. If one or more SAVE intervention is cheaper, then the most cost-effective one is selected.

Where a SAVE intervention is viable and cost-effective, this is included in the list of actions to be applied and the intervention required year is deferred accordingly.

Stage 7 - Cost Reporting

At this point, the cheapest sequence in terms of net present value and timing of the required actions will have been identified for the given strategy. The action list is processed, and the required interventions are populated into the Costing Output worksheet.

To eliminate repeated interventions to the same branch or transformer, the Intervention Period can be set on the Costing Assessment worksheet. This prevents repeated visits to a branch or transformer within the selected number of years. For example, if a transformer needs upgrading to 750KVA in 2032 and 800KVA in 2034, if the Intervention Period is set to 1, then both interventions will be included and costed. If the Intervention Period is set to 2, then the 800KVA upgrade will be brought forward to 2032.

Once all the strategies have been completed for all scenarios, the NPV for each strategy and scenario is calculated for the study end year. By altering the evaluation year, the NPV for all interventions up to that year is displayed. Note that the full list of interventions is still shown.

The final action is to populate the Regret Table worksheet.

8.3 Cost Assumptions Tab

Before embarking upon a multi-scenario costing assessment, users will need to ensure that the cost assumptions tab has been populated.

The Costing Assumptions worksheet allows users to record cost assumptions to be used in the economic analysis is shown in Figure 33. This data is stored in the backing store and does not need to be updated for every study.

Transformer Uprate

Save | Cancel

Size (KVA)	Fixed Setup
300	4811.00
315	4811.00
500	6181.00
750	26500.00
800	26700.00
1000	28700.00
2000	150000.00

SAVE Interventions

Code	Intervention	Fixed Setup	Fixed Ongoing	Variable Setup (Per 1000 Customers)	Variable Ongoing (Per Customer)
COACH	Community Coaching	7000.00	9500.00		6.00

Code	Intervention	Fixed Setup	Fixed Ongoing	Variable Setup (Per Customer)	Variable Ongoing (Per Customer)
ENGAGE	Data Led Engagement	5000.00			12.12

Code	Intervention	Fixed Setup	Fixed Ongoing	Variable Setup (Per Customer)	Variable Ongoing (Per Customer)	Variable Lightbulb Setup
LIGHTS	Low Energy Lightbulbs	0.01	0.01	0.01	0.01	0.01

Incentive Below
0
0.1
0.3

Figure 33 Cost assumptions for LV Multi-scenario

The fields that are required to be populated are:

- A fixed cost of uprating the source transformer to a new size in pounds.
- Fixed and variable costs for SAVE interventions, using the pricing structure as described in Appendix I.
- Incentive below field to enable the pricing signal assessment to be used.

All of these variables can be changed via the excel user interface or can be loaded directly into the backing store. To control cost assumptions employed by users, super users may lock key worksheets such as this along with the Microsoft Access database to avoid changes being introduced.

8.4 Costing Assessment Tab

This tab enables users to initiate a study.

Start Year	2019
End Year	2040
Interest Rate	5.00%
Number of Scenarios	4
PV Size (kW - Default)	3.5
HP Size (kWh - Default)	4000
EV Charger Size (VA - Default)	7000
Network Design Year	2033
Winter Peak Only?	Yes
Intervention Period (Years)	3
Duration of Intervention (Days)	120
Duration of Peak (Half Hours)	6
Include EGD?	No

Scenario		Load Growth					LCT Distribution			
Number	Name	Rate (%)	LCT Probabilities	PV Take Up	HP Take Up	EV Take Up	Weighting	PV Size	HP Size	EV Size
1	Low Growth	0.50%	BEIS	Low	Low	Low	Even Distribution	3.5	4000	7000
2	Mid Growth	1.00%	Custom	Low	Medium	High	Far from Sub	3.5	4000	7000
3	High Growth	1.50%	Custom	Medium	High	Low	Near to Sub	3.5	4000	7000
4	Very High Growth	3.00%	BEIS	High	High	Medium	Even Distribution	3.5	4000	7000

Figure 34 Declaration of growth scenarios in LV network multi-scenario analysis

The scenarios can be set up in the manner shown in Figure 34. Each scenario may be defined with its own characteristics or alternatively take on the global settings defined at the top of the worksheet.

The global parameters which apply to this study are:

- The start and end years which define the beginning and end of the study.
- The investment interest rate.
- The number of scenarios to be studied, which must be an integer between 1 and 4.
- Default options for the size of PV, HP and EV. These default options will be overwritten by any assumptions made for an individual scenario.
- The network design year. The design year represents a point in the future which expresses the point in the future time horizon where each capital invention is expected to mitigate all predicted overloads up to the network design date[2].
- Whether the future of the network is to be studied under winter peak only (i.e. WINTER WEEKDAY) or all seasons.
- Intervention Period – this is to prevent the upgrade of a branch or a transformer within a specified number of years. In this situation, the upgrade applied must be sufficient to meet the requirements for the period selected.
- Duration of Intervention -how many days the Price Signal is required over a 12-month period
- Duration of Peak – the number of half-hour periods in each day of the duration of the intervention

Each growth scenario can then be defined by these parameters.

- Name, which is a user-configurable field allowing the scenario to be named. This name is displayed on the Costing Output and Regret Table for identification

[2] The network design year helps users control the number of visits to a feeder for mitigation that is required. A network design year in the near future reduces the risk of stranded assets but may require repeated mobilisation of projects that conduct reinforcement on different parts of a feeder.

- Load Growth, which represents the growth in electrical consumption of non-LCT devices.
- LCT probabilities, which defines whether to use the BEIS defined LCT take-up rates or those specified on the custom worksheet.
- LCT Take up rate which prescribes which range of take-up probabilities from the LCT probabilities page is to be used i.e. none, low, medium or high for EV, PV and Heat Pumps. The take-up rate for each of these can be set independently.
- LCT distribution weighting which allows users to weight where LCT technologies are connected to the LV feeder. The possible fields are: Near to the source substation, even weighting along the feeder or, far from the source substation. This allows the user to manage the uncertainty of where the LCT will be connected.
- EV Size (Annual consumption in VA) which allows the user to state one assumption for the size of the Electric Vehicle chargers.
- HP Size (Annual consumption in kWh) which allows the user to state one assumption regarding the annual energy consumption of heat pumps that are connected into customer premises. The volume of heat pumps installed within the network is decided by the choice of LCT growth assumption and by whether the High, Medium or Low range growth assumption was selected.
- PV Size (kW) which allows the user to state one assumption regarding the size of Photo Voltaic (Solar Panel) installations.

8.5 Costing Output Tab

The Costing Output worksheet shows the results from the multi-scenario analysis.

This worksheet reports the outcome of the investment strategies which were tested. These strategies are referred to as:

- All-Knowing, in which the optimum investment strategy is determined by looking backwards from the end of the study horizon and uses both physical and SAVE interventions. Only one physical intervention will be made for any feeder or one transformer upgrade. SAVE interventions are only available to defer the first physical intervention.
- Flexibility Minimum, in which the optimum investment strategy is determined by looking backwards from the network design date and then forwards from this date to the study horizon. It uses physical interventions only.
- Flexibility Maximum, in which the optimum investment strategy is determined by looking backwards from the network design date and then forwards from this date to the study horizon. It uses physical interventions but may select a SAVE intervention to defer the first physical intervention.

Each of these strategies has its own strengths and weaknesses. For example, “all-knowing” will always offer the cheapest long-term strategy based on knowledge of the selected growth horizon. The flexibility maximum and flexibility minimum tests investment approaches which seek to avoid stranded assets by only committing to investments which resolve capacity in shorter horizons instead of the selected horizons.

Each strategy has different capacity interventions available to it. This also enables the optionality value associated with non-network solutions to be tested.

An example of the output from the multi-scenario analysis is shown in Figure 35, for each of the four growth scenarios and three investment strategies. The sequence of interventions required to avoid unacceptable loading on circuits or transformers across the substation are then listed in terms of the year they are required, the actual cost of the intervention, and the net present value of all capacity interventions across the substation and feeders.

This report shows for each growth scenario, what is the most favourable starting intervention and when it is required. When there is agreement across all scenarios as to what the most favourable starting intervention is, then that is a clear signal to the user as to what the least risk investment is.

The evaluation year is initially displayed as the study end year. By adjusting the evaluation year, the user can compare the NPV up to and including that year and compare the NPV values for each strategy whilst seeing what is (and is not) included for the selected period.

Users can infer what are favourable investment decisions from this report by comparing what the preferred investments are per scenario or year. For example, if all growth scenarios and strategies agree upon what the first intervention per feeder should be, then this is a strong signal of what the starting investment should be.

In the sample in Figure 35 shown below, there is an issue with feeder 4 in 2024. The All-Knowing and Flexibility Maximum have identified a SAVE intervention which can defer any physical intervention by three years. As can be seen in the NPV between Flexibility Minimum and Flexibility Maximum, this reduces costs by almost £4,000 as the feeder overlay is deferred by three years and for a transformer, the upgrade is deferred by one year.

Due to the amount of work required on feeder 4 (as all work for a feeder is completed in one year), then a feeder split is observed to be the most economical solution for that strategy. As the

Flexibility Minimum and Flexibility Maximum strategies identify that some of the work on feeder 4 can be deferred (up to eight years), then the solution here is to overlay.

Feeder 2 on the other hand always applies overlays. The only variation is due to the strategy rules determining when the intervention is to take place and whether incremental upgrades are possible for the Flexibility Minimum or Flexibility Maximum.

In All-Knowing, one transformer upgrade is implemented (as this is one of the criteria of this strategy), whereas incremental upgrades are shown for the Flexibility strategies. This is due to the cost of installing a new transformer compared to the cost of deferring.

In this example, the variation in results must be considered before choosing a strategy. With feeder 2, the user can be reasonably confident in what strategy to implement. With feeder 4 the choice is less clear, further scenarios with different LCT take-up and load growth may provide a clearer indication of the strategy required.

LV Multi Scenario Analysis

Evaluation year: 2040

Scenario	Strategy	Year	Intervention	Action	Actual Cost	NPV to Evaluation Year
Scenario 1 Low Growth	All Knowing Strategy	2024	SAVE Intervention	1) Low Energy Lightbulbs	49.81	316624.51
		2025	SAVE Intervention	1) Low Energy Lightbulbs	1.23	
		2026	SAVE Intervention	1) Low Energy Lightbulbs	1.23	
		2027	Split Feeder 4	1) Substation to node 54 distance 203m with WAVE 600	120880.00	
		2027	Overlay Feeder 4	1) Node 100 to node 4 distance 6m with WAVE 300	95550.00	
				2) Node 44 to node 46 distance 91m with WAVE 185		
				3) Node 47 to node 48 distance 9m with WAVE 185		
				4) Node 49 to node 50 distance 141m with WAVE 185		
		2027	Transformer	1) Upgrade capacity to 2000KVA	150000.00	
		2034	Overlay Feeder 2	1) Node 100 to node 2 distance 5m with WAVE 300	55130.00	
				2) Node 12 to node 13 distance 42m with WAVE 185		
				3) Node 13 to node 15 distance 77m with WAVE 185		
		2034	Overlay Feeder 7	1) Node 541 to node 54 distance 94m with WAVE 600	59840.00	
		2035	Overlay Feeder 6	1) Node 100 to node 6 distance 3m with WAVE 300	28960.00	
				2) Node 6 to node 72 distance 49m with WAVE 300		
	Flexibility Minimum	2024	Overlay Feeder 4	1) Node 100 to node 4 distance 6m with WAVE 600	36800.00	266565.48
				2) Node 4 to node 38 distance 34m with WAVE 600		
		2026	Transformer	1) Upgrade capacity to 750KVA	26500.00	
		2031	Transformer	1) Upgrade capacity to 1000KVA	28700.00	
		2033	Overlay Feeder 4	1) Node 38 to node 52 distance 4m with WAVE 600	53040.00	
				2) Node 52 to node 53 distance 65m with WAVE 600		
		2034	Overlay Feeder 2	1) Node 100 to node 2 distance 5m with WAVE 300	8600.00	
		2034	Overlay Feeder 4	1) Node 53 to node 54 distance 94m with WAVE 600	59840.00	
		2034	Transformer	1) Upgrade capacity to 2000KVA	150000.00	
		2035	Overlay Feeder 2	1) Node 12 to node 13 distance 42m with WAVE 185	18540.00	
		2035	Overlay Feeder 4	1) Node 44 to node 46 distance 91m with WAVE 185	86670.00	
				2) Node 47 to node 48 distance 9m with WAVE 185		
				3) Node 49 to node 50 distance 141m with WAVE 185		
		2035	Overlay Feeder 6	1) Node 100 to node 6 distance 3m with WAVE 300	8040.00	
		2036	Overlay Feeder 6	1) Node 6 to node 72 distance 49m with WAVE 300	20920.00	
		2040	Overlay Feeder 2	1) Node 13 to node 15 distance 77m with WAVE 185	27990.00	
	Flexibility Maximum	2024	SAVE Intervention	1) Low Energy Lightbulbs	49.81	261783.42
		2025	SAVE Intervention	1) Low Energy Lightbulbs	1.23	
		2026	SAVE Intervention	1) Low Energy Lightbulbs	1.23	
		2027	Overlay Feeder 4	1) Node 100 to node 4 distance 6m with WAVE 600	36800.00	
				2) Node 4 to node 38 distance 34m with WAVE 600		
		2027	Transformer	1) Upgrade capacity to 750KVA	26500.00	
		2031	Transformer	1) Upgrade capacity to 1000KVA	28700.00	
		2033	Overlay Feeder 4	1) Node 38 to node 52 distance 4m with WAVE 600	53040.00	
				2) Node 52 to node 53 distance 65m with WAVE 600		
		2034	Overlay Feeder 2	1) Node 100 to node 2 distance 5m with WAVE 300	8600.00	
		2034	Overlay Feeder 4	1) Node 53 to node 54 distance 94m with WAVE 600	59840.00	
		2034	Transformer	1) Upgrade capacity to 2000KVA	150000.00	
		2035	Overlay Feeder 2	1) Node 12 to node 13 distance 42m with WAVE 185	18540.00	
		2035	Overlay Feeder 4	1) Node 44 to node 46 distance 91m with WAVE 185	86670.00	
				2) Node 47 to node 48 distance 9m with WAVE 185		
				3) Node 49 to node 50 distance 141m with WAVE 185		
		2035	Overlay Feeder 6	1) Node 100 to node 6 distance 3m with WAVE 300	8040.00	
		2036	Overlay Feeder 6	1) Node 6 to node 72 distance 49m with WAVE 300	20920.00	
		2040	Overlay Feeder 2	1) Node 13 to node 15 distance 77m with WAVE 185	27990.00	

Figure 35 Example output from costing assessment

8.6 Regret Table Tab

To allow the user to understand the least risk investment option and value of optionality, a form of regret table is presented on the Regret Table worksheet, an example of which is shown in Figure 36.

For each strategy, the regret table lists the total NPV for each scenario and strategy and then shows how much investment regret would be experienced if the user committed to one of the three strategies. Investment regret is a qualitative expression of what is being risked by committing to one investment strategy and an alternative growth outcome occurs.

The regret is expressed as the difference between the cheapest strategy, per growth scenario and the strategy being considered. The Regret table then lists the:

- Regret per strategy per growth scenario.
- The worst least regret, per strategy, across all growth scenarios. This represents the largest investment regret associated with each strategy.
- The sum of the least regret, per strategy, across all growth scenarios.

The investment strategy that has the smallest worst least regret and the smallest sum of least regrets is the most advantageous strategy to follow.

In the case in Figure 36, the table shows that the least regret approach would be to follow the flexibility minimum strategy. Reference by the user back to the Costing Output worksheet would explain the sequence of interventions that were favoured.

It is important to understand though that this regret table compares the performance of the different investment rules for using SAVE or physical interventions and not necessarily individual interventions.

As already stressed in this document, the least regret table compares investment strategies and not fixed investment sequences. For this reason, the user should ensure that they review the recommended investment decisions and timing across each growth scenario and check the starting interventions are all the same.

	Low Growth	Mid Growth	High Growth	Very High Growth		
Strategy	Outcome	Outcome	Outcome	Outcome		
All Knowing	316624.51	336149.36	361137.62	390089.42		
Flexibility Max	261783.42	280384.58	298021.59	310889.71		
Flexibility Min	266565.48	285203.25	286872.87	306609.22		
Minimum	261783.42	280384.58	286872.87	306609.22		
Maximum	316624.51	336149.36	361137.62	390089.42		
Strategy	Least Regret	Least Regret	Least Regret	Least Regret	Worst Least Regret	Sum of Least Regret
All Knowing	54841.09	55764.79	74264.75	83480.20	83480.20	268350.83
Flexibility Max	0.00	0.00	11148.72	4280.49	11148.72	15429.21
Flexibility Min	4782.06	4818.68	0.00	0.00	4818.68	9600.74

Figure 36 Example output from Regret Table (multiple scenarios)

The regret table worksheet also allows users to compare the investment regret at different points in time by setting the assessment year on each of the four windows to different points in time.

9. Economic Assessments

In addition to the multi-scenario cost assessment described in section 8, the NIT offers two additional economic calculations:

- A stand-alone version of the network pricing tool
- A storage feasibility calculation

9.1 Price Signals Assessment Tab

The Price Signal Assessment report allows users to calculate what the magnitude of a customer price signal would be before it was a viable network capacity intervention. This assessment tab is a standalone report outside of the multi-scenario assessment process.

This method is based upon the assumption of a banded price signal model being applied to manage a winter peak loading issue.

To complete a stand-alone price signal assessment, users must specify the growth parameters using the same convention as Figure 37.

Load Growth Rate (%)	10.00%		Incentive
LCT Load Growth Probabilities	Custom		Below
PV Take Up Rate	High		0
HP Take Up Rate	Medium		0.1
EV Take Up Rate	Low		0.3
LCT Distribution Weighting	Near to Sub		
EV Charger size (kVA)	5000		
HP Size (Annual Consumption kWh)	3000		
PV Size (kW)	3.5		
Transformer Rating (KVA)	500		
Duration of Intervention (Days)	120		
Duration of Peak (Hours)	6		
Include EGD?	Yes		

Figure 37 Example of customer price input fields

The input fields to be configured are as follows:

- Background load growth rate (i.e. growth in consumption from non-low carbon technology devices).
- The set of LCT load growth parameters as that should be used in the study, as discussed in section 3.2.
- The LCT distribution weighting, where users can assign a set of assumptions regarding where on a feeder LCT should be connected in the study. Users have three options:
  - Evenly spread across existing customers along the feeder
  - Spread across existing customers on the first 50% of the feeder length.
  - Spread across existing customers on the second 50% of the feeder length

- The assumed size of a heat pump in the study, by annual consumption. (The daily load profile loaded into the study will then be scaled to reflect this size)
- The assumed size of an EV charger in the study (The daily load profile loaded into the study will then be scaled to reflect this size)
- The assumed size of an PV installation in the study (The daily load profile loaded into the study will then be scaled to reflect this size)
- The assumed size of the transformer feeding the network
- The duration of intervention in days. This is reflective of the number of days that the winter tariff would be applicable for
- The number of hours in a day that the peak tariff would be reflective for.
- Whether to run just DEBUT or DEBUT and EGD. If the study is run with DEBUT only, then the presence and growth, of photovoltaic generation will be disregarded.
- The incentive below banding, as already introduced in the price signals section of Appendix I

When the study is complete, users will be presented with a report as shown in Figure 38. This figure focuses on the transformer aspect of the report, but the available output fields are the same for each feeder within the network template that has been studied.

The first field reports the size of the winter peak overload for the feeder or transformer in question. If it is a feeder, then the overload reported relates to the first branch of the feeder only.

The field declared as the “other feeder overload” indicates whether are additional overloads observed on additional branches along the feeder or in addition to the transformer.

This application assumes that price signals are targeted at solving winter peak overloads. If any other overloads are observed on any other part of the feeder or on the transformer of either an import or an export variety, the “other feeder overload” field will turn positive. This flag is intended to warn users that price signals may not be a suitable solution and that use of the multi-scenario analysis should be considered to review the cheapest way to solve all the observed problems. This is reported across the scope of years 0 to 10 of the network in question.

The required tariff relates to the required incentive per customer that is required to motivate sufficient turndown. The overall cost of tariff confirms the total sum that would have to be spent through price signals to resolve the constraint. This is reported across the scope of years 0 to 10 of the network in question.

The third fields report the required tariff rate that will need to be offered to customers. This is reported across the scope of years 0 to 10 of the network in question and will be influenced by LCT growth.

The fourth field is the cost of the tariff which describes the cumulative incentive paid to customers to manage the network problem.

Transformer

Description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Size of Winter Peak Overload (kW)	0.00	0.00	0.00	0.00	17.40	27.30	37.60	70.30	92.20	130.20	170.00
Other Feeder Overload	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Required Tariff	0.0000	0.0000	0.0000	0.0000	0.0004	0.0006	0.0009	0.0016	0.0021	0.0030	0.0039
Cost of Tariff	0.00	0.00	0.00	0.00	151.35	237.47	327.06	611.50	802.00	1132.54	1478.73

Figure 38 Example of customer price elasticity curves

This study is only reflective of network winter peak study conditions using a banded price signal approach. This methodology assumes customers will respond to price signals in a manner that has been assigned in the manner described by each customer type (section 4.2).

Process Flow

When running the Price Signal Assessment, a study is run for each year for the Winter Peak (WINTER WEEKDAY) from the current year (Year 0) to the current year plus 10.

For each study that is run, the first action is to determine if there is an overload on the transformer or any of the feeders. If none is found, then no price signal is required.

If there is an overload, then the next check is to determine where on the feeder it exists. If it is not along the first branch from the feeder, then 'Other Feeder Overload' is set to Yes and no Price Signal can be calculated.

If the only overload is on the first branch from a feeder, then the Required Tariff can be calculated. This is calculated from the aggregated signal turndown curve. The process checks for an entry on the aggregated signal turndown curve. If a point exists, then the corresponding price signal is used. However, it is more likely that such a point does not exist, in which case the process interpolates between two points on the price signal curve (if less than the maximum value) or extrapolates from the last two points. This gives the Required Tariff and from this, the Cost of Tariff can be derived.

9.2 Storage Feasibility Assessment Tab

Users may assess whether one user-supplied electricity storage installation can be used as an alternative to any of the solutions presented within the costing output. This approach is taken using a price ceiling approach.

Storage Power (kW)	100
Storage Energy (kWh)	150
Duration of Peak	10
Costing Assessment Scenario	1
Strategy	All Knowing Strategy
Evaluation Year	2028

Figure 39 Example input for Smart Interventions report

Before the commencement of this study, the user must state the assumptions for:

- The power output of the storage unit in kW.
- The energy storage capacity of the storage unit in kWh.
- The assumed duration, in hours of the peak demand on the feeder.
- Which of the costing assessment scenarios that are the basis for financial comparison (this refers to scenario 1,2,3 or 4). The multi-scenario cost assessment must have been run before this report is used.
- Which strategy is to be the basis for comparison (i.e. All-Knowing, Flexibility Maximum, Flexibility Minimum)
- The year at which the net present worth of the costing evaluation results is to be assessed.

The storage feasibility can then review the load flow results from the LV load flow engine to decide whether the storage assumptions can be used as an alternative reinforcement. An example of this output is shown in Figure 40.

Description	Price Ceiling	Feeder	First Node	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Size of Winter Peak Overload (kW)	£76,230.00	1	3	8.9	0	0	0	0	0	0	0	0	0	0
Is storage technically feasible?				Yes										
Size of Winter Peak Overload (kW)	£41,800.00	2	25	90.1	0	0	0	0	0	0	0	0	0	0
Is storage technically feasible?				No										
Size of Winter Peak Overload (kW)	£53,537.50	3	30	103.6	0	0	0	0	0	0	0	0	0	0
Is storage technically feasible?				No										
Size of Winter Peak Overload (kW)	£66,071.00	4	48	26.3	0	0	0	0	0	0	0	0	0	0
Is storage technically feasible?				No										
Size of Winter Peak Overload (kW)	£0.00	5	56	0	0	0	0	0	0	0	0	0	0	0
Is storage technically feasible?														
Size of Winter Peak Overload (kW)	£0.00	6	62	0	0	0	0	0	0	0	0	0	0	0
Is storage technically feasible?														

Figure 40 Example output from storage feasibility report

Each feeder connected to the substation is assessed for suitability against the storage solution through:

- Use of the price ceiling, which is the interest earnt on the counterfactual investment for that feeder. For storage to be an economic proposition, then the annual cost of the utility to obtain those services must be less than the price ceiling.
- The technical feasibility assessment which checks whether the size of the largest winter peak overload on the LV feeder is smaller in terms of energy and power than the assumed storage unit.

Process Flow

When running the Storage Feasibility Assessment, a study is run for each year for the Winter Peak (WINTER WEEKDAY) from the current year (Year 0) to the current year plus 10 using the scenario and strategy details in the Costing Assessment worksheet.

If an intervention is required, the storage feasibility is checked as follows:

- The Storage Power must be greater than the peak overload; and
- The Storage Energy capacity must be greater than the Peak Overload multiplied by the Duration of Peak

If both criteria are met, then storage is technically feasible.

10. HV/EHV Module

The purpose of the HV/EHV module is to understand whether SAVE based interventions can provide a technical and economically feasible alternative to capital reinforcement of the HV or EHV system.

For the purpose of the SAVE project, the functionality of this module has been limited to dealing with network problems that are thermal loading problems under winter peak import conditions that can be resolved to a radial simplification. This decision was made as the model specification required no load flow engine to support the HV/EHV module.

This module assumes that the HV or EHV planning engineer has already determined the cheapest capital intervention and wishes to understand whether SAVE interventions can be used to defer this capital scheme.

10.1 Constraint Builder Tab

Users can apply the information from within the census interface by either specifying that the calculation should assess one single HV feeder or alternatively that a named constraint should be analysed.

The nomination of the single HV feeder or a named constraint takes place on the Assessment Runner worksheet as shown in Figure 41.

The build type allows either a “Single HV Feeder” or a “Primary System” to be selected.

If “Single HV Feeder” is selected, then the user must specify a primary substation associated with the feeder before running the study. This will result in the module using the census data for the single HV feeder within the analysis.

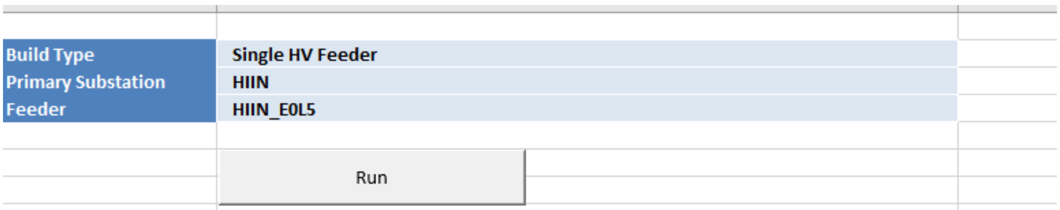

Figure 41 Selection of constraint for study

If build type “Primary System” is selected, then the user will need to nominate a constraint group that has already been declared via the Constraint Builder worksheet as depicted in Figure 42.

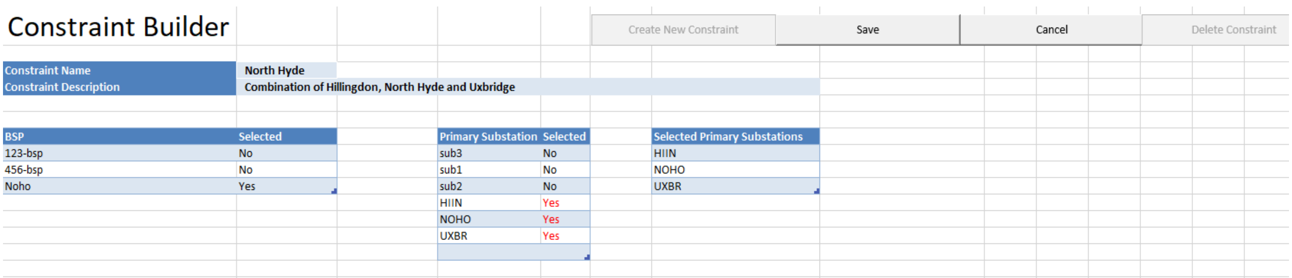

Figure 42 Constraint builder page

The constraint builder allows users to define a new constraint, by either selecting each primary substation or BSP substation. The action of setting the selection field next to a Primary substation or BSP from No to Yes adds the substation in question to the list of selected primary substations. In the case of the BSP selection, it will add all primary substations mapped to the BSP to that list.

Once the user is satisfied with the list of selected primary substations, it may be saved for use. Prior to saving the constraint, the user must name the constraint and give a brief description of what it represents.

10.1.1 Information dependencies

It is essential for the user to realise that it is assumed that prior to using this sheet, each 11kV feeder and associated with the primary substations in constraint to be studied will have been declared in the Feeder Study Substation table of the Microsoft Access database. This is the table which builds up a network connectivity model. For each feeder, the following fields need to be populated:

- ED3 primary, which is a four-letter alphabetical code declaring the primary substation node that the feeder is connected to.
- ED3 feeder, which is a four or five letter alphanumeric code declaring the circuit breaker that the feeder is controlled by
- NRN number, which is the network reference number relating to the feeder
- Substation name, which is the substation name in plain text
- Total connections, which is the total number of customers fed by the feeder
- CP01 to CP50[3]. These fields declare the proportion, of the total connections, represented by each customer type (i.e. CP code). The sum of the proportions across the 50 fields must sum to 1.

It was envisioned during the specification of this tool that the population of this table would be an administrative task carried out infrequently, rather than by every user before each study attempt.

[3] The CP number is a customer type reference number declared in section. Each customer type will have a load profile and SAVE intervention profile declared to it.

10.2 Feeder Study Input Tab

To enable the headroom and possible mitigations, the network "problem" needs to be loaded into the module. An example of the user interface for this part of the process is shown in Figure 43.

Start Year	2019
End Year	2031
Interest Rate	0.00%
Growth Assumption	1.00%
Demand Response Diversity	1.0

Save Cancel

Existing N-1 Capacity (MVA)	1.0									
	Year 0 (MW)	Year +1 (MW)	Year +2 (MW)	Year +3 (MW)	Year +4 (MW)	Year +5 (MW)	Year +6 (MW)	Year +7 (MW)	Year +8 (MW)	Year +9 (MW)
Forecast	2	2	2	2	2	2	2	2	2	2
P2/6 contribution from DG (MW)	0	0	0	0	0	0	0	0	0	0
Capacity headroom (MVA)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Time of Peak	17:30									

Reinforcement scheme name	Hilingdon E1L5
Summary of scheme	Hillingdon E1l5

Year	Year 0	Year +1	Year +2	Year +3	Year +4	Year +5	Year +6	Year +7	Year +8	Year +9
Reinforcement Spend	£1,000,000.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
New N-1 Capacity	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10 year NPC	£990,099.01									
Annual value of deferment	£10,000.00									

CMZ Assumptions		Lightbulb Assumptions		Community Training Assumptions		Data led Assumptions	
Alternative Assumption Recruitment	10,000	Alternative Assumption Recruitment	10,000	Alternative Assumption Recruitment	10,000	Alternative Assumption Recruitment	10,000

Figure 43 Feeder study input tab

This description is made in terms of:

- The start year and end year, which defines the span of the study.
- A linear growth rate expressing the background load growth applicable for the years beyond the 10-year manual forecast. The growth in years 0 to 10 should be included within the load forecast.
- The expected contribution to security from embedded generation.
- A diversity factor which reflects the aggregate difference in how different customers deliver any SAVE interventions.
- The expected annual peak electrical demand for the next 10 years for the existing network. This is entered manually by the user based on known new connections and general expectation in the background load growth.
- The increase in capacity headroom created by the cheapest reinforcement scheme. This is entered manually by the user.
- The cost of creating the new capacity headroom. This is entered manually as a time series of investments by the user.

10.3 Assessment Runner Tab

The Assessment Runner launches the analysis of the interventions and reports the technical feasibility as well as the expected cost for each intervention, an example of which can be seen in Figure 44.

This report repeats the annual value of the deferred reinforcement and the headroom deficit, as per the feeder study input page.

The total number of customers within the feeder or the constraint are also reported.

The price signal field reports the customer payment level and the total cost of intervention per year required to defer the constraint. If the size of the overload is greater than the flexibility that can be provided by customers, then the report will announce that there is 'insufficient resource'. This report assumes that customer recruitment to deliver turn down due to price signals is 100% unless defined in the consumer profiles page.

The price signal section reports:

- The total amount of turn down available within the constraint under winter peak conditions.
- The tariff signal that would have to be offered across all customers to be able to resolve the constraint.
- The cost of offering that price signal to all customers.

The low energy lightbulbs section reports:

- The total amount of turn down available if each customer within the constraint proceeded with low energy lightbulbs.
- The minimum number of customers that should be recruited to be able to resolve the HV or EHV overload with low energy lightbulbs. This assumes that the demographics of customers that are recruited represented the overall demographic. If the number of customers or turn down per customer means that it is not technically feasible to remove the overload by this method, then the calculation will report “insufficient resource”.
- The cost to deliver a low energy lightbulb strategy if every SAVE customer within the constraint is recruited.
- How much turn down is delivered if more than the minimum number of customers are recruited, again assuming that the recruitment demographic is representative of the overall feeder. If there are not enough customers to deliver this target, then this will be reported, and the calculation will not finish.
- How much does it cost, per year to recruit the increased number of customers?

The community coaching section reports:

- The total amount of turn down available if each customer within the constraint responded to community coaching.
- The minimum number of customers that should be recruited to be able to resolve the HV or EHV overload using community coaching techniques. This assumes that the demographics of customers that are recruited represented the overall demographics of the constraint. If the number of customers or turn down per customer means that it is not technically feasible to remove the overload by this method, then the calculation will report “insufficient resource”.
- The cost to deliver a community coaching strategy if the minimum number of SAVE customers within the constraint is recruited.
- How much turn down is delivered if more than the minimum number of customers are recruited, again assuming that the recruitment demographic is representative of the overall feeder. If there are not enough customers to deliver this target, then this will be reported, and the calculation will not finish.
- How much does it cost, per year to recruit the increased number of customers?

The data led engagement report shows

- The total amount of turn down available if each customer within the constraint responded to data-led engagement.
- The minimum number of customers that should be recruited to be able to resolve the HV or EHV overload using data-led engagement techniques. This assumes that the demographics of customers that are recruited represented the overall demographics of the constraint. If the number of customers or turn down per customer means that it is not technically feasible to remove the overload by this method, then the calculation will report “insufficient resource”.

- The cost to deliver a data-led engagement strategy if the minimum number of SAVE customers within the constraint is recruited.
- How much turn down is delivered if more than the minimum number of customers are recruited, again assuming that the recruitment demographic is representative of the overall feeder. If there are not enough customers to deliver this target, then this will be reported, and the calculation will not finish.
- How much does it cost, per year to recruit the increased number of customers?

The overall financial review, as depicted in Figure 45, allows a comparison of the annual cost to implement each approach. The most advantageous approach can be assessed by comparing the annual cost of implementing a SAVE intervention against the value of differing capital reinforcement.

Build Type	Primary System
Constraint	CMZ_1

Run

Annual Value of Deferred Re-inforcement	£10,000.00

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
CMZ/Price Signal	Maximum Turndown (kW) Available	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982	98982
	Required Tariff	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cost of Tariff	£0.00	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57
Low Energy Light Bulbs	Total Feasible Turndown (kW)	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906	2906
	Minimum Recruitment Target (Number of Customers)	0	858	858	858	858	858	858	858	858	858	858	858	858	858	858	858	858	858	858	858	858
	Cost to Procure	£0	£370,156	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136	£25,136
Community Coaching	Total Feasible Turndown (kW)	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448
	Minimum Recruitment Target (Number of Customers)	0	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570
	Cost to Procure	£0	£11,117	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058	£75,058
Data Led Engagement	Total Feasible Turndown (kW)	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448
	Minimum Recruitment Target (Number of Customers)	0	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570	5570
	Cost to Procure	£0	£154,616	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872	£50,872

Figure 44 HV/EHV comparison of intervention table

	Investment Requirements																					
	NPV	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Cost of Capital Reinforcement	£876,796.11	£1.00	£300,000.00	£700,000.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
Cost of Strategy Deferred by Price Signal	£18.65	£0.00	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57	£1.57
Cost to Procure Low Energy Light Bulbs	£611,276.78	£0.00	£370,156.02	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00	£25,136.00
Cost to Procure Community Coaching	£832,849.90	£0.00	£11,117.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00	£75,058.00
Cost to Procure Data Led Engagement	£697,887.02	£0.00	£154,616.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00	£50,872.00

Figure 45 Financial overview of HV/EHV solutions

11. Installation

The installation package will be supplied as a ZIP file. It is recommended that the installation take the following steps:

11.1 Installation

1. Download NodeXL (3rd party)

Node XL is the excel add in which allows users to visualise hierarchies in excel.

Install NodeXL as an excel add-in., If Node XL is not already installed, go to https://www.nodexlgraphgallery.org/Pages/RegistrationBasic.aspx and register.

A download link will be sent via email. Follow the instructions to install NodeXL

2. DLLs

In the file manager

- Create a new folder C:\Program Files\EA Technology

- Create a new folder C:\Program Files\EA Technology\SAVE

- Copy DLLs from within the ZIP file to C:\Program Files\EA Technology\SAVE

In the command prompt, type the following commands

mkdir %programfiles%\"EA Technology"

mkdir %programfiles%\"EA Technology\SAVE"

copy "<DLL Folder>"*.* *.*

3. Debut

In the file manager, create a new folder, Documents\SAVE

- Copy DEBUT.exe

- Copy DEBDAT.exe

- Copy dbdatabase.txt

- Copy dbdata.txt

- Copy dbdata.dta

- Copy dbout.wdx

4. Excel

Create the following new folders

- Create Folder Documents\SAVE\Assessments
- Create Folder Documents\SAVE\old data files
- Create Folder Documents\SAVE\Templates

Copy the following files from the ZIP file to Documents\SAVE

- Copy Reference.accdb
- Copy SAVE 0.9.xlsm
- Copy template csv files

In the command prompt, type the following commands

mkdir %userprofile%\documents\save

cd %userprofile%\documents\save

copy "<DLL Folder>"\reference.accdb *.*

copy

5. Registration

- Open a DOS Window as Administrator
- Go into C:\Program Files\EA Technology\SAVE
- Run unregister.bat
- Run register.bat

Use the following commands

cd %programfiles%\"EA Technology\SAVE"

unregister

register

11.2 Uninstallation

To uninstall the process, the following steps should be followed

1. Within the file manager

- Delete Folder Documents\SAVE
- Go into C:\Program Files\EA Technology\SAVE
    - Run unregister.bat
- Delete Folder C:\Program Files\EA Technology and all contents

2. NodeXL (3rd party)

- Uninstall NodeXL (if not used by any other applications)

12. Data take-on and update

As each installation operates independently, during trial purposes each code release is supplied with a local datastore.

If a common data structure is required, then one of the two options below should be considered as they will allow a centrally controlled data structure to be maintained and distributed, whilst allowing the end-users the flexibility to refresh/upgrade their own copy of the database when they are ready.

12.1.1 Export / Import

However, there is a facility in the Settings worksheet to allow a mass update of the following data: -

- Consumers;
- Interventions; and
- Price Curves

The steps required to do this are as follows: -

- Make the required changes to any of the above data in the database (or preferably via the Network Model Tool) on the source computer;
- Run the 'Export Data' function on the source computer;
- Find the file ExportData.csv found in the 'export' folder (under the SAVE folder);
- Copy it to the target computer's 'export' folder;
- Run the 'Import Data' function on the target computer.

No other data is currently included in this process as it is relatively static.

12.1.2 Database Updates

If changes are required to other data within the backing store, updates can be made to a master copy (held by a nominated administrator). The local data store can then be distributed to the user base.

The steps to do this are as follows: -

- Make the required changes to any of the above data in the database (or preferably via the Network Model Tool) on the source computer;
- Find the file Reference.accdb found in the SAVE folder;
- Replace the Reference.accdb in the target computer's SAVE folder.

12.2 What needs to be loaded into the backing store

All data that is required in the backing store, can be maintained through the Excel front end.

The only exceptions are

- Cables – existing cables can be maintained, but new cables would need to be added directly in the 'Cable' table in the database. Note, that if a cable is added to the database table, then an entry also needs to be added in the CABLES section of the file dbdatabase.txt

- Transformers – existing transformers can be maintained, but new transformers s would need to be added directly in the 'Transformer' table in the database. Note, that if a transformer is added to the database table, then an entry also needs to be added in the TRANSF section of the file dbdatabase.txt
- Voltage and Load bandings – these are shown in the Settings worksheet. But are alter by authorised users who have access to "tolerance" table with the Microsoft Access database.
- HV /EHV percentages. These are identified as being static and should only be changed by authorised users. However, if modification is required, then the sum of the CP fields in the database values must equal 1

It is important for users to realise that they must not make changes to any following in the local datastore (held with the Microsoft Access database) as may cause unpredictable results or cause the application to fail. It is recommended that the Access database must be write-locked and only edited by master users.

Appendix I Costing methodology for interventions

The Pricing Model is dependent on being able to cost each potential intervention before lifetime investment costs are calculated. This appendix explains how individual interventions are costed.

Incremental feeder overlay

The incremental feeder overlay represents overlaying a small section of existing LV feeder main that is already overloaded or will be overloaded within the year. The services of existing customers are transferred to this new section of cable and the old cable section is abandoned.

This intervention can be used to solve import or export overloads all year around.

It is implemented in the network modelling tool by checking what the minimum cable size required to solve the overload is. The size of the overload to be resolved is decided by the investment rules of the strategy in question.

The cost of this intervention at the year of installation is calculated by the following formula:

$$= (L \times \pounds_{CS}) + M_S + (N_{CS} \times \pounds_{SA})$$

Where

$$L = Length\ of\ cable\ section\ to\ be\ overlaid\ (Metres)$$

$$\pounds_{Cs} = Unit\ rate\ to\ install\ cable\ of\ size\ CS\ (\pounds/Metre)$$

$$M_s = Fixed\ cost\ to\ mobilise\ for\ an\ LV\ cable\ overlay$$

$$N_{Cs} = Number\ of\ customers\ connected\ to\ the\ overlaid\ section$$

$$\pounds_{SA} = Unit\ rate\ to\ move\ a\ service\ cable\ to\ a\ new\ mains\ cable\ (\pounds/Customer)$$

These cost rates are taken from the Cable Database worksheet of the Pricing Model and it is the Network Model which obtains the length of the overloaded branches. The Pricing Model may only use the cables indicated as being “selectable” for use in reinforcement.

Feeder Split

The feeder split intervention assumes that an overloaded feeder is reinforced by laying a new cable to the point on the existing feeder that is adjacent to the point which has 50% of the connected customers on either side of it. The first 50% of the customers are fed from the existing feeder and the second 50% of the customers are fed from the new cable.

This intervention can be used to solve import or export overloads all year around.

The overlay intervention is studied by checking what the minimum cable size required to solve all overload are (and installs one size only to overlay all sections). The size of the overload to be resolved is decided by the investment rules of the stratagem in question.

The cost of this intervention at the year of installation is calculated by the following formula:

$$= (L \times £_{CS}) + M_S$$

Where

$$L = Length\ of\ the\ new\ cable\ section\ to\ the\ split\ point\ (Metres)$$

$$£_{Cs} = Unit\ rate\ to\ install\ cable\ of\ size\ CS\ (£/Metre)$$

$$M_s = Fixed\ cost\ to\ mobilise\ for\ an\ LV\ cable\ overlay$$

These cost rates are taken from the Cable Database worksheet of the Pricing Model and it is the Network Model which obtains the length of the overloaded branches. The Pricing Model may use only the cables indicated as being "selectable" for use in reinforcement in the cable database

Low Energy Lightbulbs

The low energy lightbulb intervention represents the ability to reduce the power consumed under winter peak conditions by customers as a means to avoid reinforcement.

The effect of this intervention is represented by re-running the Network Model with the load profiles of all SAVE relevant customers replaced with a new load profile representing their power consumption profile as if each customer replaced all of their lightbulbs with low energy lightbulbs

The ability of this intervention to defer capital reinforcements is assessed by re-running the Network Model with these new load profiles to determine whether this intervention removes all overloads within a year and how long into the future it can sustain this for.

The cost to implement a low energy lightbulb intervention is calculated by the following:

$$= FC_{LB} + FO_{LB} + Z_{total}\,(VC_{LB} + VO_{LB}) + \sum_{n=1}^{n} Z_n \times \mathrm{CPLEB_n} \times VLO_{LB}$$

$$FC_{LB} = \text{fixed capex cost to implement lightbulb intervention}$$

$$FO_{LB} = \text{fixed opex cost to implement a lightbulb intervention}$$

$$VC_{LB} = Variable\ capex\ cost\ per\ customer$$

$$VO_{LB} = Variable\ opex\ cost\ per\ customer$$

$$VLO_{LB} = Variable\ opex\ cost\ per\ lightbulb$$

$$\mathrm{CPLEB_n} = \text{Number of lightbulbs per house or the customer type}$$

$$Z_n = Number\ of\ participants\ per\ class\ participating$$

$$Z_{total} = Total\ number\ of\ participants$$

$$\mathrm{n} = \text{Register of customer type}$$

The minimum deployment resolution for this intervention is an entire LV substation.

The low energy lightbulbs intervention is assumed to be effective on import driven overloads during winter peak conditions but not effective on overloads outside of this period nor export-driven overloads. This means that if overloads are detected upon an LV feeder within the year of analysis that is of an export nature or occurs outside of winter peak conditions, the Pricing Model will not progress this solution solutions.

Data led engagement

The Data led engagement intervention represents the use of the learning from the SAVE project with regard to how data-led engagement can be used to manage capacity on the LV network.

The effect of this intervention is simulated by re-running the Network Model with the load profiles of all SAVE relevant customers replaced with a new load profile representing their power consumption profile as if each customer had responded to the data led engagement campaign.

The ability of this intervention to defer capital reinforcements is assessed by re-running the network Model with these new load profiles to determine whether this intervention removes all overloads within a year and how long into the future it can sustain this for.

The cost to implement a data-led engagement campaign is calculated by the following:

$$= FC_{DL} + FO_{DL} + Z_{total}\,(VC_{DL} + VO_{DL})$$

$$FC_{DL} = \text{Fixed capex cost to implement a data led engagement intervention}$$

$$FO_{DL} = \text{Fixed opex cost to implement a data} - \text{led engagement intervention}$$

$$VC_{DL} = Variable\ capex\ cost\ per\ customer \text{ to implement a data led engagement intervention}$$

$$VO_{DL} = Variable\ opex\ cost\ per\ customer \text{ to implement a data led engagement intervention}$$

$$Z_{total} = Total\ number\ of\ participants$$

The data led engagement intervention is assumed to be effective on import driven overloads during winter peak conditions but not effective on overloads outside of this period nor export-driven overloads. This means that if overloads are detected upon an LV feeder that is of an export nature or occurs outside of winter peak conditions, the Pricing Model will not progress data led to engagement solutions.

Community Coaching

The community coaching intervention represents the use of the learning from the SAVE project with regard to how community coaching can be used to manage capacity on the LV network.

The effect of this intervention is simulated by re-running the Network Model with the load profiles of all SAVE relevant customers replaced with a new load profile representing their power consumption profile as if each customer had responded to the community coaching programme.

The ability of this intervention to defer capital reinforcements is assessed by re-running the network Model tool with these new load profiles to determine whether this intervention removes all overloads within a year and how long into the future it can sustain this for.

The cost to implement a data-led engagement campaign is calculated by the following:

$$= FC_{CC} + FO_{CC} + Z_{total}\,(VC_{CC} + VO_{CC})$$

$$FC_{CC} = \text{Fixed capex cost to implement a data led engagement intervention}$$

$$FO_{CC} = \text{Fixed opex cost to implement a data} - \text{led engagement intervention}$$

$$VC_{CC} = \mathit{Variable\ capex\ cost\ per\ customer}\ \text{to implement a data led engagement intervention}$$

$$VO_{CC} = \mathit{Variable\ opex\ cost\ per\ customer}\ \text{to implement a data led engagement intervention}$$

$$Z_{total} = \mathit{Total\ number\ of\ participants}$$

The community coaching intervention is assumed to be effective on import driven overloads during winter peak conditions but not effective on overloads outside of this period nor export-driven overloads. This means that if overloads are detected upon an LV feeder that is of an export nature or occurs outside of winter peak conditions, the Pricing Model will not progress community coaching solutions.

Transformer uprating

This intervention represents a situation where the capacity of the HV/LV transformer needs to be increased. It is implemented in the Network Model tool. This tool is aware of a list of transformer sizes and associated costs. Depending on the investment strategy being considered, a transformer size is selected to meet the expected capacity requirements.

This intervention is costed based on a unit cost to change an existing transformer.

In the event that there is an insufficient transformer size in the library, the user will be informed via a warning message. The user will then have to either increase the size of transformers available in the library or consider the development of an additional HV/LV transformer site away from the substation in question.

Price Signals

The price signals intervention applies learning from the SAVE project with regard to how price signals to customers can be used to manage capacity on the LV network. This intervention could represent a condition where price signals are conveyed to customers through DUoS tariffs.

Each customer type will be represented by an elasticity relationship which determines the amount of “turn down” in electrical power consumption that each customer type would be expected to give, under winter peak consumption conditions for a given price signal. By aggregating these characteristics to represent the population of an LV feeder or an entire secondary substation, an understanding of the feasibility of whether this intervention is a feasible approach to managing the network will be provided.

The price signals process may be used in either the multi-scenario analysis or the stand-alone price signal assessment.

The process of using price signals assessment is as follows:

1. The magnitude of any overload upon the source transformer or the first branch of any of the feeders is captured from the Network Model. This may also be applied in the HV/EHV module. This intervention does not resolve overloads further down the feeder from the first branch or beneath the constraint boundary modelled.

2. For each feeder and transformer, in turn, assess the size of the price signal that is required to achieve a sufficiently large turn down to resolve the overload for the next three years The required cost signal is established using price elasticity curves per customer type as defined in the Price Curve worksheet of the Pricing Model and also the insensitivity bands that are defined on the cost assumptions page.

   Figure AI.1 shows how sets of price curves can be used to represent different customer types based on SAVE project learnings once they are published.

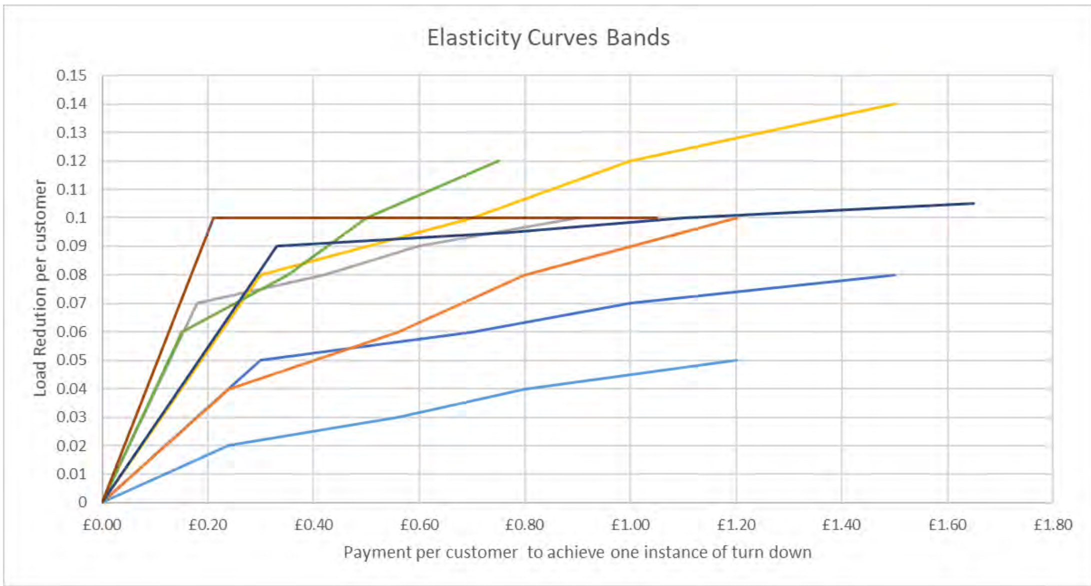

Figure AI.1 Example of customer price elasticity curves

These represent the elasticity curve for each customer type, and they describe the load reduction offered per customer type and the consequential payment that is required to motivate that reduction. However, to replicate the effect of a common tariff structure, the price signals assessment page, requires the input of the price signal versus insensitivity table, as shown in Figure AI.3.

Price Signal	Insensitive Below Target
0	0
0.15	0.15
0.25	0.35
0.35	0.5
0.45	0.75

Figure AI.2 Tariff table

By constructing a look-up table which aligns each of the tariff points in Figure AI.2, aggregating the elasticity curves up by the number of customers per type with the expected recruitment rate per type an overall turndown curve for the feeder or constraint in question is produced, as shown in Figure AI.3.

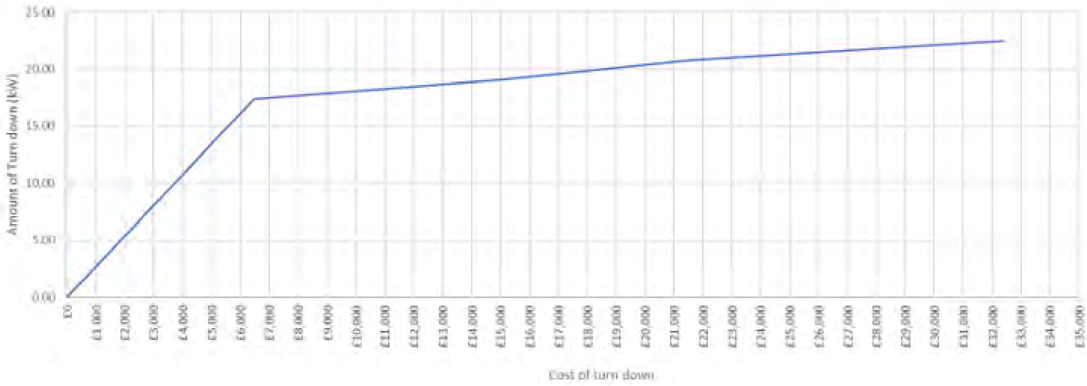

Figure AI.3 Overall turn down curve for a feeder or constraint

The amount of payment is in effect the average payment to the customer type as this value is scaled by the expected recruitment rate across a population of the customer types. The number of customers used to develop these curves would be specific to a feeder or transformer and informed from the Customer Model. The individual curves from Figure AI.1 are then be aggregated into an overall cost versus the turndown curve as shown in Figure AI.3.

3. From the cost signals observed, the process will identify the one cost signal that needs to be applied to all customers across the secondary substation to resolve overloads on the transformer and each of the feeders.

4. Present the annual cost of price signals forwards into the economic assessment. Price signals will only be considered as a viable strategy if the annual cost of implementing price signals is less than the annual interest earnt on the cheapest capital intervention

The price signal applied is representative of the banded price signals approach and it assumes that there is an elasticity curve per customer. A graphical illustration of the elasticity curves per customer type is shown in Figure AI.1.

The following assumptions are applied to the use of price signals:

- The minimum application resolution for price signals is one whole secondary substation
- Price signals are only used to resolve import overloads on transformers and the first branch out per feeder during winter peak conditions. If the network analysis tool detects overload on any other location on the feeder or an export overload
- The annual cost of the pricing intervention is assessed over the number of days that the tariff is required to effect a change i.e. 90 days for the winter period
- The domain of a feasible solution is limited to the first and last data points defined on a curve, which means that if the overload is greater than the bounds of the overall turndown curve, the network problem cannot be solved by the elasticity curves nominated.
- Price Signals are seeking to achieve a turndown between 16:00 and 20:00 on winter weekdays.

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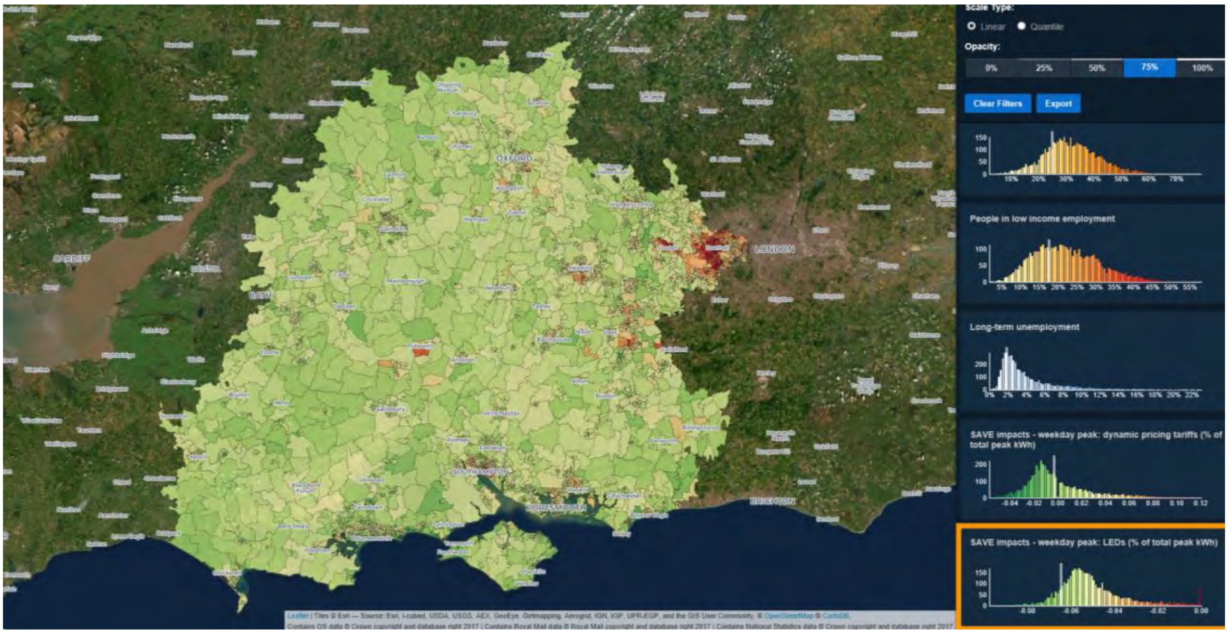
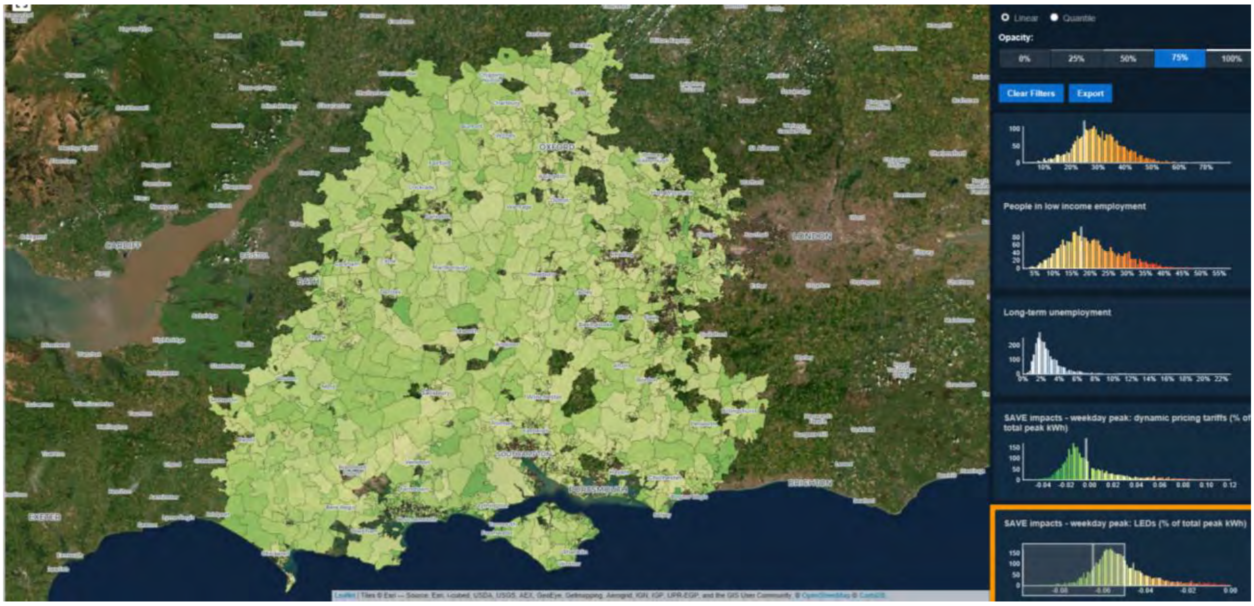
Appendix 2.1 - SSEN Mapping tool

Uses Low Super Output Area (LSOA) census data to understand presence of vulnerability, priority service register (PSR) customer for stakeholder engagement purposes. Can also be layered with smart network considerations including, presence of vehicles, electric heating and most recently impact of SAVE interventions (energy efficiency, dynamic tariffs).

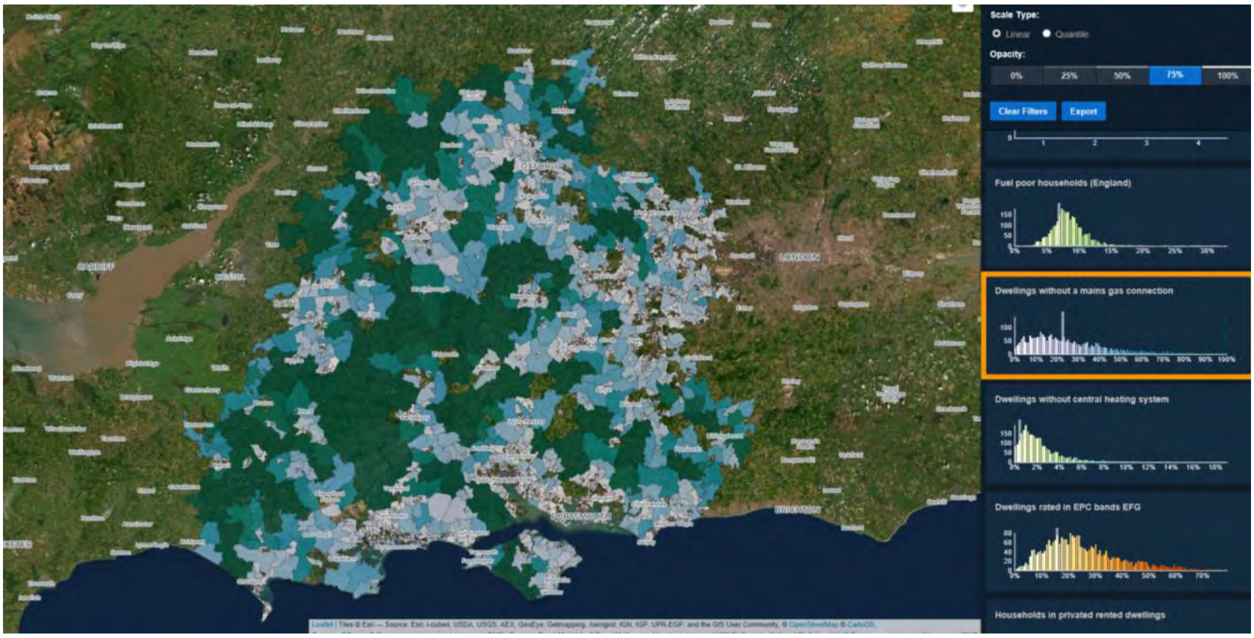
The screen shot below shows how we might first look into % impact on LED rollout could have across our patch. Darker green indicating a higher level of load reduction and red a lower level of load reduction (as per key on right).



We can then select to see just those areas reducing demand by over 5% as a result of LED's as below, by highlighting parts of the key.



This can then be layer with any number of variables to understand impacts, for instance below we have layered with presence of mains gas to show areas with over 5% reduction in demand through LED's and colours showing % of households off mains gas (darker blue= less gas)



Scottish & Southern Electricity Networks

Solent Achieving Value from Efficiency

SAVE

Solent Achieving Value from Efficiency

Appendix 2.4a

TM4 (Community Energy Coaching Trial)

SSET206 / LCNF Tier 2 SDRC 8.8: Supplementary Appendix

Post-Trial Review

'One Year On'

January 2019

University of Southampton · DNV·GL · Neighbourhood Economics · Future Solent

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.

Prepared By

Document Owner(s)	Project/Organisation Role
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Version Control

Version	Date	Authors	Change Description
0.1	21/12/18	NEL	First draft - internal
1.0	17/01/19	NEL	Incorporating SSEN edit
2.0	21/01/19	NEL	Final report with Appendices

CONTENTS

A full Glossary of Terms and list of acronyms used in CEC Trial reporting is included in the main Report of Findings: http://www.neighbourhood-economics.com/the-save-project/

1 THE COMMUNITY ENERGY COACHING (CEC) TRIAL – ONE YEAR ON

1.1 CONTEXT

1.1.1 The Post Trial 'One Year On' Review

This Report is a Supplementary Appendix to the Final Report for the SAVE Community Energy Coaching (CEC) Trial (SDRC 8.8, June 2018). It sets out the results of the post-trial Review undertaken by Neighbourhood Economics in November 2018, one year on from the end of the 2 year active research phase of the trial.

1.1.2 The Aim of the Review

The core hypothesis for the CEC trial was that:

> *"Measurable changes in localised consumption behaviours generally – and in terms of peak energy demand reduction in particular – are more likely to be achieved with key local and national stakeholders working intensively together to resource and empower defined geographical communities in actively embracing a compelling, locally relevant, collaborative sustainability-related theme. Furthermore, resultant positive behaviour change is more likely to be reinforced and sustained in the long-term by the momentum of pooled stakeholder effort".*

The aim of the post-trial Review was to test implicit assumptions in the core hypothesis regarding the sustainability of behaviour change impacts attributable to the collaborative coaching approach. As such, the Review explored the legacy of the active research phase of the project as it could be observed a year on.

1.1.3 Key Success Criteria

With the formal closure of the trial at the end of 2017, we were hopeful of being able to draw conclusions about the relative levels of sustained commitment to the principles of peak demand reduction and multi-agency collaboration. As such, we identified 3 key success criteria. We postulated that:

a) There would be a continuing commitment to behaviour change amongst at least 50% of local customers who signed up to the BSO events delivered as part of the active engagement phase of the research in November 2017;

b) The energy efficiency theme coupled with an understanding of the peak demand issue would be embedded as part of the agenda of local community-based organisations with evidence of delivery on Legacy Plan commitments;

c) Utilities and other stakeholder agencies part of the Stakeholder Group for the CEC trial would be continuing to collaborate in developing operational relationships and in designing and delivering joint community engagement initiatives as part of business as usual (BAU) activities.

Also, given the passage of time since the end of the formal trial research, we were keen to assess the relative levels of 'decay' in commitment to change amongst different types of participant (customers, local community groups, stakeholder partners) and potentially to draw conclusions about how these levels might in retrospect have been improved in a comparable operational situation. In terms of behaviour change amongst customers in particular, we assumed that a year on, 50% of original trial participants or less would still be able to express a sustained commitment to active peak demand reduction.

1.2 SUMMARY OF SDRC 8.8 RESEARCH FINDINGS

1.2.1 The Original CEC Trial

The CEC Trial was one of four trials conducted as part of the SAVE behaviour change research programme as funded through the Low Carbon Network Fund. The trial aimed to test within 2 differentiated communities in Kings Worthy (Winchester) and Shirley Warren (Southampton) whether a sustainable reduction in peak electricity demand could be achieved working in collaboration with local communities. If successful, this would allow SSEN and any other Distribution Network Operator (DNO) to reliably manage demand to defer / avoid reinforcement on constrained parts of a network.

The trial's community-centric approach also offered the opportunity to address energy consumption within the context of the wider community well-being and service delivery agendas important to other partner agencies and the communities themselves.

The research was undertaken in partnership with other utility companies and stakeholders, including SGN (Southern Gas), Southern Water, University of Southampton, Eastleigh, Winchester and Southampton Councils, VIVID (formerly First Wessex), Winchester Action on Climate Change and the Environment Centre in Southampton.

The 2 year active engagement phase of the CEC trial (2016 and 2017) is now complete and the final report of findings was submitted to Ofgem in July 2018. The full report and appendices can be downloaded at http://www.neighbourhood-economics.com/the-save-project/

The 3 other trials under SAVE are focused upon sample groups of households across the whole of the Solent area. These trials continue to run through 2018 and will report next year.

1.2.2 Summary of the original Research Learning

Full exposition of the 18 Learning Outcomes from the Trial research is set out in Section 4.4 of the Final Report, June 2018. Key findings can be summarised in the following learning points:

- 'BIG Switch Off' events achieved over 10% reduction in peak demand on specific substations
- Being part of a caring, connected community was the key driver for behaviour change
- Shifting peak demand was seen as a compelling new energy literacy message
- Making emotional connections with the community was crucial in securing active participation

- Messenger identity was key … customers responded much more positively to messages from the locally branded intermediary groups – Shirley Warren Working Together (SWWT) and Connecting Kings Worthy (CKW)
- Talking about saving time as well as about saving energy broke down the barriers to changing cooking routines
- The multi-agency coaching approach was seen as transformational in delivering stackable benefits for all involved including other utilities and stakeholders.

2 ANALYSIS OF CEC TRIAL LEGACY

2.1 THE REVIEW PROCESS

2.1.1 What we did / What we found / What we concluded

Reflecting the key Success Criteria (1.1.4 above) this analysis sets out briefly what we did as part of the post-trial review process in November 2018. It reports on what we found in following up with the 3 separate specific interest groups - customers, local community groups and stakeholder partners - and accordingly what we concluded in terms of the sustainability of behaviour change as observed at the close of the trial at the end of 2017.

2.2 THE CUSTOMER LEVEL

2.2.1 What we did

We knew from customer interviews and substation monitoring as part of the original BSO research interventions that on selected feeders in both trial communities, 25% customer sign up could deliver measurable peak demand reduction in excess of 10% for a defined constraint period (See Section 4.1, Final Report, June 2018).

One year on, we re-interviewed a random selection of households who had formally signed up to the original BSO events in November 2017. In all we conducted 25 doorstep interviews in each trial area to assess performance against the notional success criterion of at least 50% of local customers expressing a continuing commitment to behaviour change

2.2.2 What we found

Crucially:

- A sustained commitment to active peak demand reduction as expressed by 80% and 72% of customers interviewed in Shirley Warren and Kings Worthy respectively, an average of over 75% across the 2 areas combined (Question 3, Appendix 1);
- Customers in both areas citing examples of continued peak reduction activities which reflect key ‘energy literacy’ campaign messages notably changing cooking / eating routines and shifting usage of key appliances (Question 4, Appendix 1);
- 68% and 60% of customers in Shirley Warren and Kings Worthy respectively stating that they would continue to encourage others to reduce peak demand (Question 6, Appendix 1).

The detailed interview questionnaire analysis is set out in Appendix 1.

2.2.3 What we concluded

From our follow up household interviews, we concluded as part of the Review that:

- A year on, there was an encouraging level of continuing commitment to reduced peak consumption as expressed by over 75% of customers across the 2 areas as compared to the assumed 50% or less success criterion level . This can be expressed in terms of the rate of decay of qualitative behaviour change impacts as a 'half life' of 2 years;
- There was no evidence of any real difference in levels of continuing commitment between the trial areas.

2.3 THE COMMUNITY LEVEL

2.3.1 What we did

We knew that there was an 'in principle' commitment to embedding energy efficiency as part of wider community agendas expressed by SWWT and CKW in Legacy Plans agreed at the end of the original trial research period. These plans are the embodiment of the 'trusted local intermediary' status of SWWT and CKW in effectively conveying behaviour change messages beyond the active trial. (See Section 4.3.4, Final Report, June 2018).

As part of our 'one year on' review, we met individually and collectively with local community representatives who had been part of the original co-design teams through SWWT and CKW to explore progress with delivery of these legacy commitments. Detailed updates for each trial area are set out in Appendix 2.

2.3.2 What we found

- Generally there is a good record of delivery in both areas although this has been more demonstrably achieved in Shirley Warren. Of the 10 legacy commitments taken on in each community, 7 have been or are being delivered with 3 in process in Shirley Warren while in Kings Worthy, 5 have been or are being delivered with 4 in process and one as yet uncertain;
- Of the 2 communities, energy literacy messages around energy efficiency and peak demand reduction are observably more fundamentally embedded in Shirley Warren through the work of SWWT. We can readily put this down to the relative paucity of other 'competing' groups and the regular community café and associated activities set up as part of the trial and still continuing to provide a focal point for collective action to improve community resilience. Through SWWT conversations around energy have broadened to take in wider sustainability and environmental issues with residents now feeling empowered to take action, both on an individual basis and as a community, as a result of their involvement with SAVE. Some modest support continues to be provided by the Environment Centre (tEC) as the original local host organisation;
- In Kings Worthy, CKW remains one of a large number of groups requiring volunteer support to sustain their activities with potential support more dissipated as a result. While individual groups have taken up the CKW mantle in their own way, notably St Mary's Eco Church, the Worthy's Festival, the Primary School and Parish Council, it has been more difficult for the

community to routinely filter action through CKW. On one hand the brand is still seen positively within the community as providing an overarching and neutral focus for both energy and the wider sustainability/environmental issues that are now being discussed; on the other, levels of community resilience in Kings Worthy are intrinsically high with no particular urgency to coalesce under the CKW banner. Some modest support continues to be provided by Winchester Action on Climate Change (WinACC) as the original local Host organisation;

- In both communities the 'bottom up' nature of the coaching approach was confirmed as critical to both their original enthusiasm to be involved and their continued engagement with the key energy literacy issues beyond the end of the active research phase. Residents feel that they have been listened to, valued, supported and trusted as part of the CEC trial, particularly so in Shirley Warren. This has been the catalyst for positive social change, allowing people to come together and believe in themselves in a way that other initiatives/projects have not. In both communities, being seen as 'part of the solution and not just part of the problem' was key to the project being able to add value to community wellbeing as well as them being able to add value, support and take ownership of the trial through the co-design process. These findings echo learning captured through the active research phase of the trial (See Section 4.2.6, Final Report, June 2018).

2.3.3 What we concluded

From our individual and collective meetings with community representatives, we concluded as part of the Review that:

- SWWT was and remains a fundamental factor in local resurgence of community activity in Shirley Warren over the past 2 to 3 years. Led by key individuals from the local Action Church, it has provided an inclusive focus for self-development of the community. As a formally constituted group, it now continues to grow feeding on the need for increased community resilience and the urgency for social action. It is well-placed to generate significant additional resources to sustain itself and also to support local investment projects;
- In Kings Worthy, the plethora of local groups made initial engagement relatively easy, but the ongoing need to service them all is leading to an increased pressure on a limited number of local volunteers who, although interested and willing, are finding it difficult to maintain the level of commitment required to sustain CKW as a separate entity. CKW remains a known and trusted overarching and neutral local brand which, through social media networks is continuing to provide a virtual space for the promotion of community wide initiatives and information. In order for CKW to play a more central developmental role it would benefit from an additional modest input of funding/support, over and above that which WinACC can currently continue to provide;
- Of the 2 trial areas, the SAVE legacy through SWWT has been more fundamentally significant from an overall community wellbeing viewpoint. The pre-existing levels of community activity and associated resilience – very low in the case of Shirley Warren and very high in the case of Kings Worthy – have played a significant part in determining the degree to which respective legacy commitments are now embedded locally. The implication is that if SSEN and/or other stakeholder partners were to apply coaching principles in similar local engagement elsewhere, working in the least resilient / most vulnerable communities is likely to yield both the more enduring behaviour change and the more significant uplift in social wellbeing;

- A modest ongoing support package in each trial community bridging the end of the active trial period would potentially have seen greater reach/traction achieved with the opportunity to embed the work of SWWT/CKW more deeply. In particular it would have helped to broaden the reach of activity across the community in Shirley Warren and to recruit new volunteers to maintain and reinforce the role of CKW.

2.4 THE STAKEHOLDER / PARTNER LEVEL

2.4.1 What we did

We knew from legacy scoping work as part of the original trial research that:

- utility partners and other stakeholders have been impressed with the nature and success of the CEC approach and had already begun to apply some of the lessons learned within their own organisations and to their work with other partners: for example, Eastleigh Borough Council changing the focus of its promotional messaging around reuse and recycling; SSEN and Southern Water looking at future collaboration with a view to shared resourcing around household level behaviour change, the value of Priority Services Register (PSR) sign ups and other social impacts for vulnerable customers; increased networking and formal recruitment of stakeholder representatives to the boards of tEC and WinACC enhancing future partnership working;
- the utilities in particular recognise the value of delivering a range of stackable benefits potentially offering both value for money and an improved customer journey, especially for vulnerable customers. In addition, the Local Authorities and host organisations saw the model of private sector led engagement as a potential breakthrough in future joint working giving the resource challenges that they, along with other partners, currently face. These points echo learning captured through the active research phase of the trial (See original feedback from Stakeholders captured in Section 4.2.6, Final Report, June 2018).

Looking beyond the energy sector to wider community wellbeing / resilience policy, we had also as part of our original trial reporting explored a prototype Connected Communities Programme with a view to scaling up the CEC trial research to a viable BAU roll-out programme embracing a broader civic responsibility agenda beyond the energy sector (See Section 4.4.3, Final Report, June 2018).

Against this background, we convened ‘one year on’ a special Review Session with the Stakeholder Group to revisit the legacy from the trial. Alan Whitehead (MP for Southampton, Test and Shadow Minister for Energy and Climate Change) was also in attendance.

2.4.2 What we found

- There is consensus amongst the project Stakeholders that the set of Community Engagement Guidelines as put together to build upon learning through the CEC trial, should be shared within their own organisations to promote and underpin future good practice. These guidelines are set out in Appendix 3;
- SSEN are actively applying the learning from the CEC trial and the wider SAVE project in building upon their current Constraint Managed Zone (CMZ) initiative. This is a BAU initiative to commercially secure demand management/power injection services to

defer/avoid network reinforcement on defined parts of a network. Building on this, there is an opportunity to explore the potential for a Social CMZ initiative incorporating contributions from other stakeholders alongside commercial operators and looking at delivery of social benefits (reflecting utility companies' social obligations) alongside demand management. The initiative is being formally developed prior to being opened up through a public tender process. The proposed SCMZ model is described in Appendix 4;

- The Stakeholders all continue to endorse the coaching approach taken by the CEC trial and value the wider social benefits, as delivered alongside peak demand reduction, particularly those for vulnerable customers. There is continued support in principle for further collaboration to generate 'stackable' social impacts on a more cost-effective basis. Given the challenge of delivering a scaled up version of the CEC model cost effectively, this support is more likely to be actualised through the evolving SCMZ initiative led by SSEN in the near future rather than through any wider roll-out programme potentially linked to the wider community wellbeing / resilience agenda;
- Quantification of the value of social impacts remains a particular issue in relation to the measurement of cost effectiveness in any future collaborative work to generate stackable benefits (See Section 3.4.4, Final Report, June 2018);
- It was agreed that there are policy lessons to be learned from the CEC trial research and the wider SAVE project looking at its applicability to both energy / carbon policy and wider community wellbeing. The key principles underpinning the CEC trial could usefully be applied in a public policy context, notably (i) the value of a trusted local intermediary (ii) recognising the primacy of the community's role in driving behaviour change (iii) seeking to combine the service agencies' 'top down' interests with a community's 'bottom up interests to empower local change and (iv) the efficiencies of multi-agency / cross utility working.

2.4.3 What we concluded

From our follow up discussions with stakeholder partners, we concluded as part of the Review that:

- There is general consensus that the community coaching approach remains ground-breakingly good within the experience of the stakeholder partners involved. Project learning continues to be applied, both formally and informally, building upon the key principles of the CEC trial. The fundamental principle of recognising the primacy of the community's role in driving behaviour change remains the most difficult to subsume within routine operational practice;
- The Community Engagement Guidelines put together on behalf of the Stakeholder Group offer an agreed benchmark for future joint working by the stakeholder agencies involved;
- The development of the Social Constraint Managed Zone (SCMZ) initiative through SSEN provides a natural opportunity for BAU application of many of the lessons learned from the CEC trial and the wider SAVE project. Effective business case development will require a clear framework for evaluating the benefit of targeted / attributable social impacts;
- Alongside the SCMZ initiative which builds directly on the needs of the energy / utilities sector, there remains an opportunity for multi-agency collaboration addressing wider community wellbeing / resilience policy. Whereas leadership of the SCMZ opportunity lies clearly with the SSEN, agency capacity to pursue a wider civic responsibility agenda is less clear.

3 RECOMMENDATIONS

3.1 RECOMMENDATION 1: Community Engagement Guidelines

Given the level of positive support for the Community Engagement Guidelines put together on behalf of the Stakeholder Group and the associated evidence base built up through the research trial, it is recommended that SSEN and/or other partners within the energy industry should seek to establish an industry-wide protocol for future work within local communities based upon these Guidelines;

3.2 RECOMMENDATION 2: Social Constraint Managed Zones

The development of SCMZs, building upon SSEN's current Constraint Managed Zone initiative, offers the best opportunity for capturing and applying the learning from the CEC trial and the wider SAVE project in the immediate future. Building upon current CMZ application, it is recommended that SSEN should continue to explore the BAU case for an SCMZ initiative incorporating contributions from other stakeholders alongside commercial operators and looking at delivery of social benefits alongside demand management;

3.3 RECOMMENDATION 3: Evaluation of Attributable Social Impacts

Reflecting the experience of the CEC trial in generating social impacts (alongside core peak demand reduction), any similar engagement work targeting attributable social benefits will require a clearer framework for quantification and evaluation. This will potentially apply to both new initiatives such as SCMZs and also to more routine delivery against social obligations. As such it is recommended that SSEN and/or other partners should seek to establish the necessary consensus framework;

3.4 RECOMMENDATION 4: Wider Application of Research Learning

Although unclear at this stage who might lead it, there remains an opportunity for multi-agency collaboration addressing wider community wellbeing / resilience policy beyond the interests of the energy sector. Complementing the energy / utilities sector focus of the SCMZ initiative, this could facilitate further exploration of the fundamental principle underpinning the CEC trial approach, that is, recognising the primacy of the community's role in driving transformational behaviour change across a broader civic responsibility agenda. It is recommended that SSEN and/or other public sector partners should explore further options for resourcing follow-on work to assess the viability for BAU roll-out of such a programme.

APPENDIX 1 – BSO PARTICIPANT FOLLOW UP SURVEY

BSO PARTICIPANT FOLLOW UP SURVEY

Doorstep Interview Questionnaire Analysis, November 2018

		Shirley Warren		Kings Worthy	
		% yes*	comment	% yes*	comment
1.	Do you remember joining in the event, 6-7 pm on 19 November 2017?	92		88	
2.	If so, what particular things did you do to reduce energy usage?		14 comments: • Switch off lights etc x3 • Not use appliances 6-7pm x7 • As per Factsheet advice x2 • Went out for evening x2		14 comments: • Switch off lights etc x5 • Not use appliances 6-7pm x2 • As per Factsheet advice x4 • Went out for evening x3
3.	Have you continued to try to reduce electricity consumption during the peak period – 4-8pm?	80		72	
4.	If so how?		12 comments: • Generally economical x3 • Changed eating times x3 • Use slow cooker • Not use appliances 4-8pm x2 • New LED bulbs • Have cut bills by 50% • Smart meter installed		19 comments: • Generally economical x5 • Changed eating times x3 • Batch cooking • Not use appliances 4-8pm x5 • New LED bulbs x3 • New boiler installed • Smart meter installed
5.	(a) SWWT has organised another BSO event on 9 November. Will you be joining in? (b) If CKW organised another BSO event, would you join in?	76		80	
6.	Would you encourage others to reduce peak hour electricity consumption?	68		60	
7.	If so why?		5 comments: • Because of substation peak issue x4 • Environmentally sound		12 comments: • Because of substation peak issue x5 • Environmentally sound x4 • Save money • Community responsibility x2

* per 25 interview sample

APPENDIX 2 – LEGACY PLAN UPDATES

ORIGINAL LEGACY PLAN - CONNECTING KINGS WORTHY	UPDATE: ONE YEAR ON	
Connecting Kings Worthy Looking a year ahead, the CKW Development Group want to build on the neutrality of the CKW brand and see it used to underpin the 'specialness' of Kings Worthy as an active and 'connected' community. Specifically they want to:		
• Actively use the CKW brand to continue to promote both energy saving and wider environmental messages, including those started through SAVE;	CKW Facebook page actively being used to promote both energy / wider environmental / sustainability and community based issues	
• See the Group continue to meet on a quarterly basis to provide a focus and drive to ensure the brand continues to be used/developed;	Current group members have found it difficult to find a gap within the busy calendar of other regular group activity to suit all needs so attendance at meetings has been very low	
• Use the CKW brand at upcoming Church and School fairs to promote specific community wide energy/environmental messages linked to the development of the 'Eco-Church' and school curriculum in the first instance;	Continued promotion through Church Rep and coach's legacy activity	
• Build on St Mary's Church's aim to become an 'eco' church and make the wider community aware of the background and potential impact along with opportunities for reinforcing energy and environmental messages/action;	Church Rep an active supporter of CKW and keen to see it continue – also now on the Parish Council so has other opportunities to encourage and broaden the reach	
• Maintain use of the CKW website and FB page to promote associated local activity;	Static webpage with an actively updated Facebook presence seen as the way forward.	
• Building on a local visioning exercise, to create exemplar community buildings where the community can see for themselves the difference energy efficiency measures can make through for example. Solar PV and a public display unit;	The Parish Council have agreed to install Solar PV on Tubbs Hall and are keen to demonstrate energy savings to the wider community	
• Continue to look at the opportunity to develop a 'Sustainable KW' strategy which all groups could independently adopt as part of their BAU practice;	This remains an aspiration but lacks the 'person' resource to promote and carry through	
• Work with the SSEN Customer Relations Team to update the parish resilience plan;	Parish Council happy to engage but ball with SSEN CRT at present	
• See the development of a SAVE app as a legacy of the project which would have a simple slide calculator to show impact in money saved of energy efficient actions undertaken for example slow cookers, shorter showers etc. This would require ongoing, external support;	This remains too big an aspiration to achieve without additional ongoing external support.	
• Continue to receive support from WinACC for on the ground help to enable the group to deliver on these aspirations.	Ad hoc low key support available based upon WinACC's limited resources (former coach lives locally)	

ORIGINAL LEGACY PLAN - SHIRLEY WARREN WORKING TOGETHER	UPDATE: ONE YEAR ON
Looking a year ahead, the SWWT Development Group want to see SWWT actively continuing to promote energy saving messages, including those started through SAVE, alongside activities to promote wider social benefit. In particular:	
• They want to see if they can undertake a BSO in November 2018 to build on 2017's successful event;	BSO event 2018 successfully took place on Friday 9 November 2018**
• They want to continue to promote the 'can it wait 'til after 8' message and other energy saving messages to encourage people to use less at peak times but through regular 'touch point' activities rather than set piece events;	These messages continue to be promoted through the Communnity café and other regular 'touch point' activites and with a recent newsletter delivered to all households
• They would like to see a slow cooking club where people could learn how to use slow cookers and benefit from both the time, cost and energy savings to be made but would need some additional resource/staff/volunteer time to enable it to happen. If there was an opportunity to tie in with a 'healthy eating' type project to access additional help/support that would make it more achievable;	This remains an aspiration but is a lower priority given the external resource required. Slow cookers continue to be used at lunch club and other community events, such as the BSO, so continue to be promoted informally through these activites.
• They intend to continue to undertake regular clean ups to reach further into the community helping to restore pride in SW and the way it looks;	Clean ups continue to take place on a 6 weekly basis with the last one on the 17 November 2018
• They would like to see the new Community Café built at the front of the Action Centre and in operation – with an 'eco' focus (or similar) to actively embrace energy issues by using energy efficient appliances, looking at environmentally friendly use of disposable (compostable) cups and plates rather than using the dishwasher, possibly having solar panels to generate its own electricity, energy saving messages and information being available to users and so on;	Background work continues to get local councillor and pre-planning support for a modular café at the front of the centre but a % of match funding is needed prior to submission of a grant application for capital funds and this has yet to be raised.
• They would like continued access to the materials designed for the project, for example, the fridge magnets, information sheets and so on;	A stack of matarials were ordered before the end of the project to ensure continued access and were in evidence at the BSO
• They would like to invite Alan Whitehead (MP for Southampton) to talk to them about wider energy policy issues that they are interested in exploring as a result of the project, raising mutual awareness of the impact of energy and environmental policies upon local residents. They will look for a suitable opportunity to do this;	NEL invited Alan Whitehead to attend a final Stakeholder review session hosted, by agreement, at the SW Action centre by the SWWT team providing an opportunity for a sharing of learning from the trial and for a wider policy discussion.
• They would like to try and integrate energy into other community activities and make it something that they do across the board as a matter of course – embedding the learning locally.	This occurs naturally through the community café and other regular SWWT and church actvities
• Making the most of the links they now have with tEC, they would like to access energy efficiency support/ tie in with other available projects and with other organisations for broader support as needed;	Money Saving event organised by tEC to support BSO on 9 November 2018. Ongoing individual household advice continues to be available to SW residents as well as general support for SWWT activites
• They are happy to engage with SSEN Customer Relations team staff to look at community resilience planning.	SWWT happy to engage – ball with SSEN CRT at present.

** high level analysis of the impact of the repeat BSO event as measured at substation feeders is attached at Appendix 5

APPENDIX 3 – COMMUNITY ENGAGEMENT GUIDELINES

COMMUNITY ENGAGEMENT GUIDELINES

An opportunity for stakeholder endorsement of good practice lessons from the SAVE Community Energy Coaching Trial

Given the very positive feedback from residents and stakeholders alike to the coaching approach, SSEN and its partners in the SAVE Project Community Energy Coaching (CEC) Trial are pleased to endorse a set of good practice guidelines for successful community engagement.

Key learning from the trial has been distilled down to 5 headline guidelines to underpin efforts to achieve deeper and more sustainable behaviour change through community engagement:

- Understand the local agenda before seeking to introduce your own – 'top down' information or community campaigns typically start with the agency-led issue that needs to be addressed and can take relatively little account of (i) the complementary needs or interests of the recipient community (ii) the context in which communication will be received and (iii) the corresponding willingness or ability of residents to engage or act. By starting from the 'bottom up' and understanding the needs and aspirations of the target community, 'top down' campaign messages can be tailored to suit, with willing community partners sharing ownership of the issue. 'Earning the right' is key;
- See the community as part of the solution not part of the problem – often the people with the better ideas for addressing a problem will be those closest to it. Using a co-design approach can harness the expertise of 'in house' industry experts along with the wider knowledge and experience of local stakeholders and residents. Blending different perspectives into locally tailored solutions will provide more traction and greater local buy-in than something perceived as 'imposed' or 'parachuted in'. It is more likely that customers will respond badly or not at all, if they feel 'done to';
- The need for change does not lie only within communities – service organisations and public agencies can subject communities to an ongoing cycle of change requests: 'eat more of this', 'less of that', 'use less of this' and 'save more of that'. The expectation is that the need for change lies within each individual, household, community but rarely within the organisations and agencies themselves. If we really want to create new social norms we need to interact positively with those we seek to change and be prepared to change ourselves and our traditional ways of working in the process, taking time to appreciate local circumstances and build mutual understanding;
- No one size fits all - communities are multi-faceted and complex. From a local perspective a single issue, 'silo' tick box approach to service delivery and problem solving is likely to be perceived as a frustrating waste of time. For an effective appreciation of the core needs within a community, engagement needs to be sustained and relatively non-prescriptive with an opportunity to involve a range of service providers who, acting together, can make a real difference against a commonly agreed agenda;
- Ensure wherever possible that the importance of consistent relationship building is not always superseded by urgent operational demands – a bottom up, co-design approach takes time and commitment to deliver results and consistent success is based upon the quality of the relationships that can be developed and maintained. Trust in service agencies is slow to be established at the community level but quick to evaporate when commitments made routinely give way to other urgent operational demands.

These good practice guidelines will typically apply in all operational situations involving groups of customers and are likely to be of particular relevance to utility companies and their partners in seeking to deliver core social obligations in a more meaningful and sustainable way. The CEC trial has demonstrated that in adopting a more collaborative, multi-agency style, the positive outcomes of community and customer engagement can be both more effective and more durable.

SAVE – Solent Achieving Value from Efficiency

Scottish & Southern Electricity Networks

NEIGHBOURHOOD ECONOMICS

APPENDIX 4 – SOCIAL CONSTRAINT MANAGEMENT ZONE (SCMZ) MODEL

SSEN's SCMZ model is designed to take learning from the SAVE project to improve and open the DNO's flexibility procurement to locally based and socially oriented organisations. This will allow for a fair and visible procurement process for such organisations to compete for flexibility alongside larger flexibility providers who have typically dominated the market.

Prior to the innovation of SCMZs SSEN procured its flexibility through a service called Constraint Managed Zones (CMZs). CMZ's have typically been identified in areas of the network whereby network capacity triggers have signalled load-growth on a substation that could take it beyond capacity in the near future. This would traditionally be managed through network reinforcement. A CMZ looks to allocate a provision of the funds that would be used on reinforcement (based on the net present value of postponing reinforcement for the duration of a CMZ term- typically 4-6 years) to provide a price ceiling in which network service providers (that is, battery providers, aggregators etc) can competitively tender to provide their solution as an alternative means of managing peak demand.

As the SAVE project trials have progressed SSEN has (i) been able to evidence that energy efficiency and domestic DSR can actively impact the network (particularly the project's LED trials which have attributed a 5-7% reduction in domestic peak demand); (ii) provided evidence into the value and capacity for stakeholders to work together in community energy efficiency initiatives, laying a blue-print for stacking benefits and collaborative working to rollout network management solutions (see SDRC 8.8 Community Energy Coaching Final Report, June 2018).

Taking this learning into business as usual through SCMZs, SSEN is working to ensure that community groups have visibility of the DNO's need for flexibility and are stimulated to both be able to participate, and build collaborative (co-design/stacked) business cases to deliver flexibility services directly to the DNO. For instance a local council might be rolling out energy efficiency across their borough, it may be that an SCMZ provides a geographical price incentive for them to increase their energy efficiency campaign across the households served by the DNO's SCMZ site, allowing the council to stack funding for their initiative and expand it. Through market stimulation the DNO may even be able to facilitate collaboration with wider service providers, such as gas and water utilities to rollout joint utility customer benefits allowing for access to even more revenue streams and a more competitive/cost-effective network management tender. Market forces of a competitive tender process would drive price and allow the DNO to procure the most cost-effective and/or socially optimal solution to manage their SCMZ.

APPENDIX 5 – ANALYSIS OF BIG SWITCH OFF 9TH NOVEMBER 2018[1]

Reflecting a Legacy Plan commitment as set out in Appendix 2, Shirley Warren Working Together organised a second Big Switch Off event during the evening 4-8pm peak on Friday 9 November 2018, notionally for the period 6-7pm. A high level analysis of the impact of the repeat event as measured at substation feeders was undertaken by SSEN as follows:

Step 1

Electricity consumption (expressed in kWh) was measured for the whole of Shirley Warren using substation feeder data for the 24 hours of the BSO day divided into 10-minute intervals. Figure 1 shows consumption for the trial day, the week before and week after. It indicates the relationship between high consumption and low temperature, showing specifically a divergent correlation between consumption (solid line) and temperature (dotted line) for the trial day. The notional switch off period, 6-7pm, is highlighted between the two blue vertical lines.

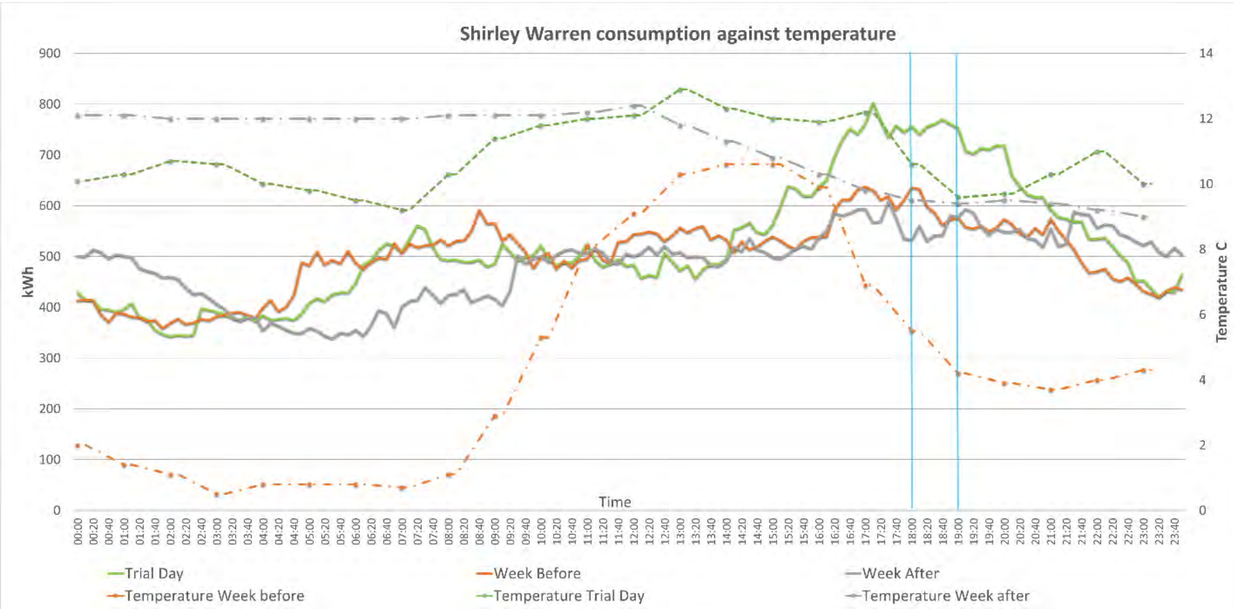


Figure 1 Shirley Warren 24 hour

Step 2

Looking at specific feeder analysis, Figure 2 shows consumption as measured at Bindon Road[2] feeders for the trial hour, the hour before, hour after, week before, week after, day before and day after. It is possible to observe slight load reductions for the trial hour on Feeder 3 of 6.9 kWh as compared to the hour before and 9.6 kWh compared to the week before. Is also possible to observe for Feeder 3 that the consumption on the trial hour is lower than the both the day before and the

[1] This Appendix should be read in conjunction with Section 3.4.2 in the Final Report (June 2018) which addresses issues regarding feeder level analysis and Section 4.1.6 which sets out the original BSO impact analysis for trial and control area feeders.

[2] These are the feeders targeted for the original BSO event in November 2017. As part of this Post-trial Review, we also revisited households on these feeders who had signed up in 2017 to assess their continuing commitment to reduced peak consumption – see Section 2.2.2 above.

day after. Given variability across feeders a reduction of this scale cannot be quantified as statistically robust.

	Feeder 1	Feeder 2	Feeder 3	Feeder 4	Tot usage
Trial hour	20.5	46.6	85.9	65.6	218.6
hour before	24.9	45.4	92.8	65.4	228.5
hour after	44.9	43.3	81.8	59.7	229.7
week before	32.0	44.7	95.5	76.5	248.7
week after	26.0	48.5	79.7	73.7	227.8
Day Before	24.27	46.89	87.08	58.93	217.2
Day After	25.98	46.31	88.16	58.35	218.8

Figure 2 Bindon Road substation: the graph shows the mean consumption on trial hour for the trial day, hour before, hour after, week before, week after, day before and day after

Step 3

Finally, data was further normalised by comparing trial feeders with a range of similar control feeders[3] for the trial day. Figures 3 and 4 show measured consumption for representative Bindon Road feeders, C and D, between 5pm and 8pm (with the notional trial hour, 6-7pm, highlighted) as compared with control area feeders outside of Shirley Warren. For both trial feeders results are largely inconclusive over thee peak period.

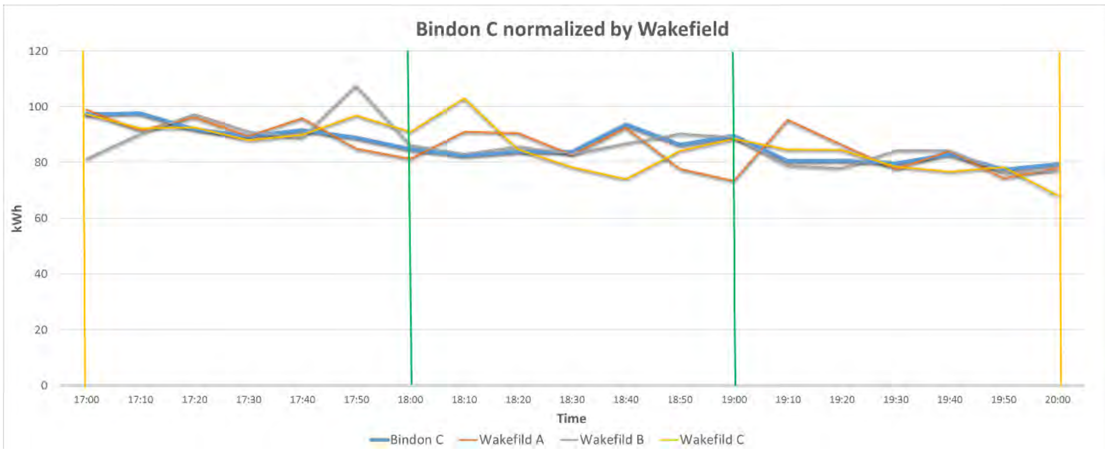


Figure 3 Bindon C: the graph shows the trend of consumption on the trial day for the feeder Bindon C normalized by Wakefield A, B and C

[3] See Final Report (SDRC 8.8, June 2018) Section 4

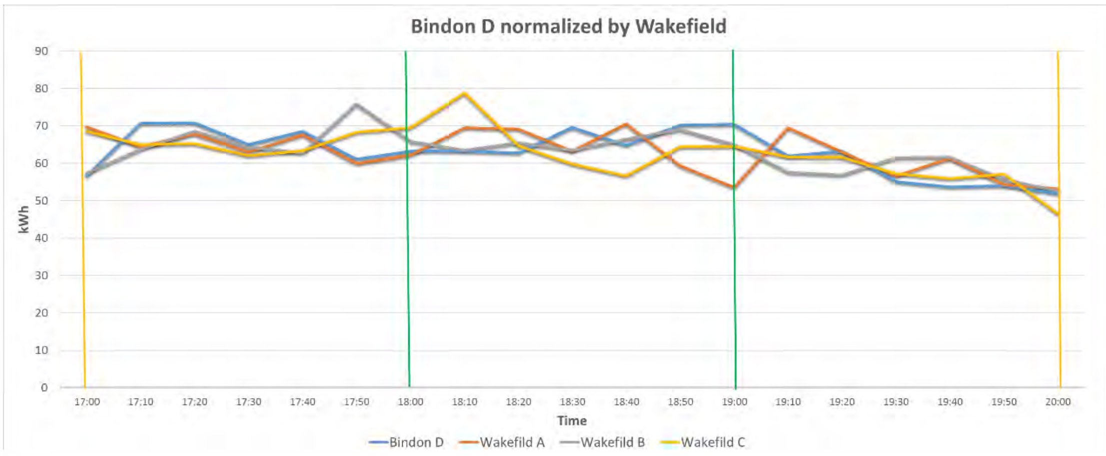


Figure 4 Bindon D: the graph shows the trend of consumption on the trial day for the feeder Bindon D normalized by Wakefield A, B and C

Overall Findings

Overall, the analysis has shown a higher consumption on the trial day, compared with the week before and week after for Shirley Warren as a whole. Looking at individual trial feeders, it is possible to observe for Bindon substation that usage drops by 30 and 10 kWh on the trial hour compared with the week before and week after respectively, however such reductions were not seen when comparing to other variables and hence outcomes remain inconclusive. The qualitative work completed in the report above, supported by anecdotal evidence in this appendix reinforces the encouraging level of continuing commitment to reduced peak consumption.

NEA

Action for Warm Homes

Appendix 2.4b
Solent Achieving Value through Efficiency (SAVE) Supplier Workshop Report

A report provided by NEA to SSEN May 2019

Contents

Introduction

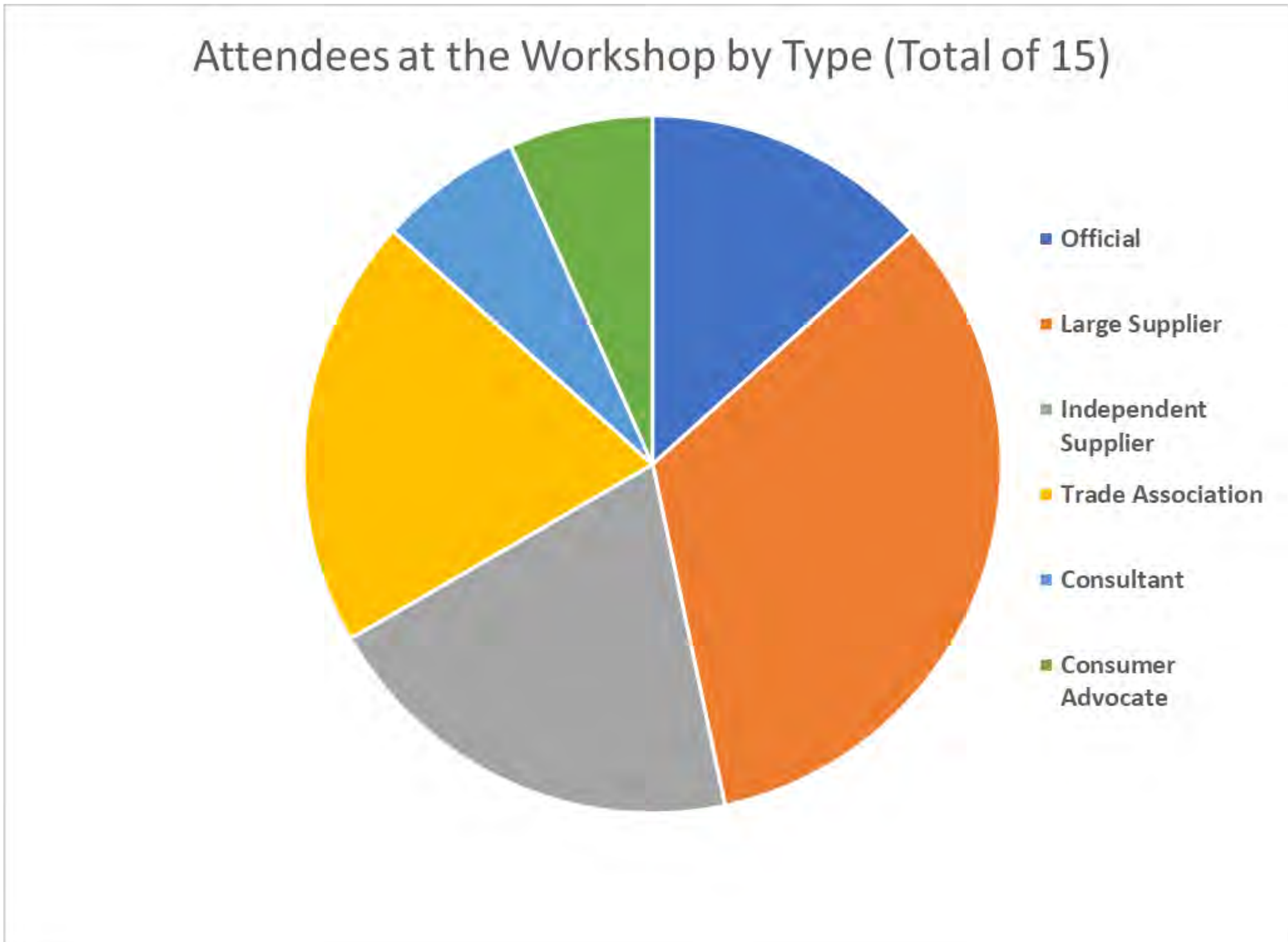
The Solent Achieving Value through Efficiency (SAVE) project is a network innovation project funded through the Low Carbon Network Fund (LCNF). Its aims are to rigorously trial and establish to what extent energy efficiency and behaviour change measures can be a cost-effective tool for managing peak demand, specifically as an alternative to traditional network reinforcement. The project aims to understand the demand side response (DSR) capability of residential customers through four approaches: installation of LED lighting, price signals, enhanced engagement and education, and community coaching.

If these methods prove to be an effective alternative to network reinforcement, DNOs could choose to deploy them to a wider audience following the conclusion of the SAVE project. However, the use of at least two of these methods, energy efficiency and price signals, could be heavily supported/challenged through suppliers being able to facilitate them from both a regulatory and commercial level. Therefore, to test that the solutions would be viable alternatives to network reinforcement outside of an innovation project, NEA worked with SSEN to develop and host a workshop to test the findings of the project with energy suppliers and other stakeholders.

In order to ensure that the workshop provided as much value to the recommendations of the SAVE project as possible, NEA and SSEN worked together to determine attendees, speakers, and workshop format. It was decided that as suppliers would be crucial in taking the project from innovation to business as usual, the event should be focused on getting the views of this sector. Large suppliers, independent suppliers and trade associations were therefore approached in order to achieve a wide range of views. NEA and SSEN also identified several speakers for the workshop, including BEIS, who were invited to speak about the future of local flexibility markets and the future of the Energy Company Obligation. It was also decided that NEA would give a brief overview of how DNOs can help to address fuel poverty through innovation work and other channels. The workshop was designed to get feedback on both the trials (which SSEN would themselves present to inform the audience before a facilitated discussion) and associated reports (where Citizens Advice and DNV-GL would present on essential capacity and the SAVE regulatory recommendations respectively before a facilitated discussion). The invitation to the event can be found in annexe 1, whilst the agenda can be found in annexe 2.

The workshop served to obtain feedback from suppliers on the SAVE project regulatory report (produced by DNV GL), as well as a research project being completed by Citizens Advice "Essential Capacity" utilising SAVE's project data. The workshop included introductory scene-setting presentations from Government Officials and NEA. SSEN then presented on the findings from the LED and price signal trials before NEA conducted a facilitated discussion to obtain supplier views. Citizens Advice and DNV GL then presented on their respective pieces of work before another facilitated discussion to get supplier views on these topics. The collated views will help SSEN to form a set of recommendations on how to take the project from innovation into business as usual.

15 people outside of SSEN and NEA attended the event. Annexe 3 provides a full list of the organisations that attended and presented at the event. The pie chart below highlights the broad categories attendees were represented from. In addition to the workshop, a 1:1 interview was offered to interested suppliers who could not attend the day. OVO Energy, an independent supplier, took up this offer and have therefore also fed into this process.



Feedback from the Breakout Sessions

For each of the four topics set out above, a set of overarching questions were asked. The following table shows these for each topic. On each table an NEA facilitator helped ensure the focus of the discussion remained relevant and promoted further discussion on the key areas. NEA also provided a scribe on each table. As with the table facilitators, care was taken to ensure the scribes had relevant background knowledge on the topic to ensure feedback was captured accurately.

Energy Efficiency	Price Signals	Essential Capacity	Regulatory
Does DNO investment in energy efficiency fit in with ECO? What could be done beyond ECO to ensure that investment in energy efficiency is beneficial in terms of DNO costs?	Do you agree that price signals can be an effective way of changing the shape of demand? How do you expect Time of Use Tariffs to look? Are current supply market arrangements set up to facilitate a DNO-led price signal through a time of use tariff?	Do you think that having an 'essential capacity' would be a good idea? What do suppliers need to be able to successfully implement such a charging mechanism? Does this generally fit with how you see the energy world changing over the coming decade?	What are your views on the regulatory insights and recommendations? Are there any conflicts of interest in suppliers also recommending these?

Table 1- Key Questions for discussion

The following section of the report covers each topic separately and brings the main insights together in a conclusion. However, it should be noted that discussions were often fluid, moving from one area to the other. This highlights how none of these areas can be looked at in isolation.

Supplier Feedback – SAVE Energy Efficiency Trials

The SAVE project conducted several trials to determine whether offering energy efficiency to households in an area of electricity network constraint could reduce their peak usage. This was done through several methods, including offering discounts to LEDs in an opt-in trial, and offering LEDs for free to households in what was essentially an opt-out trial. Focus was given to the more successful later trial which achieved a 47 W reduction per household at peak times. Scaled across the UK, this would be the equivalent of approximately 1.3GW reduction in peak which is roughly the same capacity as the UK's largest nuclear plant.

Outside of the innovation project, energy suppliers could play a key role in helping households to install energy efficiency measures to help alleviate network constraints. This is because the Energy Company Obligation (ECO), is a supplier-led obligation, focused on improving energy efficiency standards in low income and fuel poor homes. As the available money for this scheme could be 'stacked' with any money available from an electricity network trying to resolve a constraint, it could be a cost-efficient way to achieve a peak reduction through energy efficiency in domestic households. As it is their obligation, suppliers will hold a key role in facilitating such efficiency improvements. Therefore, SSEN reached out to suppliers in a workshop setting to discover supplier views on the legitimacy of such an idea and how it might work in a business as usual environment, answering some key questions (set out in Table 1). This section explores the responses to these questions, and reaches some conclusions based on these responses.

How does DNO investment in energy efficiency fit in with ECO?

Large suppliers said that there had been very limited interactions with DNOs in their delivery of ECO. This was partly due to the limited scope of electricity-led devices[1] within the ECO scheme but also a lack of knowledge and understanding of how DNOs could help obligated suppliers to fund or facilitate measures delivered through the programme. Whilst the current level of interaction with DNO investments was evident, some suppliers noted recent developments within the ECO policy could make alignment easier. For example, there is now an allowance for suppliers to perform certain innovation projects within the ECO budget, which gives suppliers more flexibility in delivering the scheme. Although LEDs are not currently covered within the ECO scheme, this innovation allowance might give an entry point for installations that reduce electricity demand at peak periods. Secondly, "local authority (LA) flexibility" has been expanded within the ECO programme, this could allow LAs to work with suppliers and DNOs to define geographical areas where reinforcement is required and prioritise these homes for interventions without the need for ascertaining household-level eligibility or complex data-sharing.

In addition, Independent suppliers commented that whilst the principles of the scheme match well with what would be needed to fit in with DNO investment, the scheme was currently focused on reducing the amount of energy used. If it were to fit better with the DSO agenda, there would need to be a shift that

[1] ECO is mainly focussed on reducing heating demand, therefore is only likely to benefit DNOs in electrically heated homes.

recognised the cost reduction available for households that can be achieved from shifting demand, not just reducing it.

What could be done beyond ECO to ensure that investment in energy efficiency is beneficial in terms of DNO costs?

Officials noted that some companies work to blend funding from Warm Home Discount industry initiatives and other sources. They also said that ECO is currently focused on space heating and is limited by the legislation that governs how suppliers can meet the obligation.

One supplier said that value can be stacked between DNO investment, ECO, local authority schemes and others to have the greatest impact. As ECO is the only national scheme in England, there is a not insignificant amount of funding that is only available locally through local government. This might fit in with the DSO agenda, but only if funding aligns with constraint.

It was suggested that there may be some opportunities being missed already, where reinforcement is being avoided through reinforcing the network due to customer upgrades already taking place.

Funding for energy efficiency schemes outside of the ECO scheme was also discussed with several identified:

- Participants outlined that there are government-funded schemes in both Wales and Scotland namely Nest and ARBED in Wales and Home Energy Efficiency Programmes for Scotland. It was highlighted that this meant that there was already more potential in these countries to stack any DNO investment alongside money available from these energy efficiency schemes.
- It was also noted that the Renewable Heat Incentive (RHI) could help fund district heating which has the potential to drastically reduce usage in buildings that are currently electrically heated. For example, high density areas like high-rise block flats can be switched from electric heating to wet central heating systems under the current scheme. Participants did however note that potential would only be realised if the RHI is retained in some form post 2020 when it is due to end.
- The fuel poverty gas extension scheme, administered by gas distribution networks, means that fuel poor households can access subsidised, and often free, gas connections which can mean switching away from electric heating to a gas boiler, drastically reducing peak electricity demand.
- Ofgem's reform of access and forward-looking charges will change certain electricity network connection and usage rules, with shared access to a connection being discussed which could help shift a peak;
- Warm Home Discount Industry Initiatives, where suppliers contract third parties to undertake projects helping vulnerable customers as part of their Warm Home Discount obligation can include funding for capital measures. AgilityECO and their LEAP project are providing home visits and LED bulbs for vulnerable customers, which if targeted effectively could help alleviate network stress.

Beyond ECO 3

To set the context, it was explained that the UK Government's 2018 Clean Growth Strategy committed that ECO (or an equivalent programme with the same annual expenditure) will be extended to 2028. Whilst the Government have yet to set out the full detail of the scheme, it is assumed that to honour the commitments on the fuel poverty strategy to prioritise this limited assistance towards households who are in or at most risk of fuel poverty, the scheme will continue to have a broadly similar focus.

Participants therefore also discussed what should happen beyond the current version of ECO, which runs until 2022. As well as the possibility of a more varied measure mix, the groups discussed how far a DSO should contract with 3rd parties, and the important role for close to real time network maps to reduce the barriers for 3rd parties competing as much as possible, providing an easier way with visibility where the pinch points are on the network. The SCMZ is a positive development. It was suggested that platforms such as Piclo have helped to increase visibility, and that there should be an ambition from DNOs to improve visibility more generally within RIIO 2.

For longer-term visibility, it was suggested that National Grid's annual 'Networks Options Assessment' gives a long-term view on the roadmap required.

Conclusions

There was a lack of awareness from the groups about the potential for the ECO scheme to provide not energy efficiency measures in network constrained areas. Participants felt that the scheme is moving in a direction that could facilitate more innovative thinking like this however, and there will be an opportunity in the next iteration of the scheme, ECO 4 which starts in 2022, to have a scheme which has a more whole systems focus.

There are some other schemes Great Britain apart from ECO which could be used to co-fund measures, including national, government funded schemes in Wales and Scotland. There are also smaller, more localised schemes in England that may be useful from a Network context, but funding is on a much smaller scale.

Supplier Feedback – Price Signals

The SAVE project conducted trials to determine whether offering financial incentives to reduce consumption at certain times of day to households in an area of electricity network constraint could reduce their peak usage. There were several methods for doing this, including offering direct financial rewards for a percentage reduction in peak usage and the SAVE project team's bespoke design 'peak banded' price signals with hourly rewards for keeping below a set consumption level. The trials included both opt-in and opt-out methods.

Within the innovation project, these price signals can be easily offered by a network. Within a business as usual context, however, a supplier would likely be needed to pass through such incentives to a customer. SSEN therefore decided to reach out to suppliers to get their view on some key questions (set out in Table 1). This section explores the responses to these questions, and reaches some conclusions based on these responses.

Are Price Signals Effective?

Attendees generally agreed that price signals can be effective in the right conditions. There was a consensus that customers will need to have a high level of trust in their supplier to engage with a time of use tariff at all, as there is the potential to end up paying more than they otherwise would have done on a fixed rate tariff.

Whilst some suppliers suspected that there might be some drop-off in the effectiveness over time after initial engagement with a time of use tariff, an independent supplier remarked that their own experience with a time of use tariff suggested that a reduction in peak demand up to about 30% might be achievable, but that this was potentially due to the customers being early adopters and therefore more amenable to consuming flexibly.

There was a consensus that many customers value convenience and that some are prepared to pay more (or save less) to enable them to live their lives exactly as they want and are sometimes not prepared to modify their routines and lifestyles for relatively small and uncertain savings. Simplicity in tariffs and behaviour change requests is essential. Customers are more likely to respond to signals to think twice about using non-essential appliances between 4 and 7 than prices that change daily at variable times.

There was agreement that automation is key to the success of time of use tariffs. The less that an individual must do to respond to a price signal, the more likely there is to be a response. As an example, devices could have an algorithm that dictates when they consume energy depending on the price of a tariff at certain times. Electric vehicles will have a large role to play in automating flexibility at home, as there is high potential for the battery to charge at different times of the day. Some appliances can do this now, but there is a need for this to greatly expand. An independent supplier argued that early adopters must be used to shape the future as they are currently the most engaged and can use a semi-automatic solution and influence product/system evolution. Some people are even creating their own apps to do this now.

Others said that customers don't always need a saving or incentive to modify behaviour, for example the plastic bag levy was presented to illustrate that no one ever published annual household savings from using reusable bags, and re-useable coffee cups are 'trendy' resulting in major reduction in cup issue.

What will Time of Use Tariffs Look Like?

An independent supplier had already released a time of use tariff and said that they can be created to be as simple or as complex as is required. They said that the tariffs are likely to be driven by underlying price signals, which are determined by the pricing structures of network charges and the wholesale electricity market. Once these price signals are strong enough, then suppliers will look to pass these on to customers, as there will be a commercial reason to do so.

One participant commented that the prevalence of EVs is likely to shape the form that many time of use tariffs take. Others argued that regulatory decisions, such as Ofgem's targeted charging review, and network access and forward-looking charges significant code reviews will be crucial in defining what time of use tariffs will look like. Distribution use of system (DUoS) charges could form a large part of the price signal, so their shape will have a big impact on the tariff shape. An independent supplier commented that the granularity of the locational signal is especially important.

Suppliers agreed that whilst they might have the ability to create tariffs in all shapes and sizes, that many customers will need them to be simple in order to respond to the price signal and reduce their peak.

Are current supply market arrangements set up to facilitate a DNO-led price signal through a time of use tariff?

An independent supplier argued that the arrangements are absolutely in place to facilitate a time of use tariff, as they already have one on offer for domestic customers. Other attendees argued that whilst they are indeed possible now, suppliers need to settle energy bills on a half-hourly basis to be able offer a time of use tariff, which requires a move to half-hourly settlement as well as the installation of a smart meter.

Several suppliers also suggested that it isn't just arrival of technical market arrangements that will dictate when time of use tariffs become prevalent, but also the level of the price signal that arises from such arrangements. For example, if Ofgem's Targeted Charging Review and Access and Forward-looking charges SCR were to erode the strength of a network price signal that could be passed onto customers, then it would make it considerably less likely that time of use tariffs would be created and offered. The current smearing of DUoS might not be a big enough signal, but if Ofgem's changes were to enhance a signal, then some suppliers would be keen to offer a time of use tariff sooner.

Conclusions

Attendees generally agreed that price signals can be an effective mechanism in the right conditions. There was a consensus that automation of demand is key (either through smart white goods, batteries, electric vehicles or other smart demand). Time of use tariffs are likely to come in many shapes and sizes, but they will be constrained by customers' ability to deal with complexity. The market arrangements are already in place to facilitate time of use tariffs, but smart meters, half hourly settlement and sharp price signals will be required before they appear at scale. The outcome of Ofgem's network access and forward-looking charges SCR is therefore crucial.

Supplier Feedback – Essential Capacity

Alongside the SAVE project and Ofgem's Network Access and Forward-Looking Charges SCR, Citizens Advice have been doing some work to understand the merits of defining 'essential capacity' for domestic customers and whether a charging methodology that included a discounted rate for such a level of capacity, followed by a greater charge for exceeding that capacity, might be a good idea. As suppliers would be key to facilitating such a set of charges, SSEN reached out to them in a workshop setting to discover views on essential capacity, answering the key questions: Do you think that having an 'essential capacity; would it be a good idea?; What do suppliers need to be able to successfully implement such a charging mechanism?; Does this generally fit with how you see the energy world changing over the coming decade? This section explores the responses to these questions, and reaches some conclusions based on these responses.

This topic was a relatively new concept for most attendees, so much of the initial discussion was focused on ensuring that participants fully understood the work so that feedback could be as informed as possible.

Is essential capacity a good idea?

An official remarked that in Italy, there is a charging methodology based on a maximum power that a household can draw from the grid, and that people have adapted to respond to this and work within the limitation. If households want to have access to more power, they can pay for an increased rating BUT only if the network can handle it. The official said that this seemed to work quite well, but there was not an acceptance from the rest of the group that this would easily translate to the UK.

An independent supplier argued that essential capacity would stifle incentivisation for flexibility and that instead of trying to protect customers, we should be looking to include as many customers as possible in the energy transition and empower them to manage their demand. Many of the customers that Ofgem label as 'vulnerable' are very engaged and already manage their demand, so they should be able to benefit from a system that rewards flexibility. One large supplier remarked that consumer protection might be better in the form of a social tariff cap, such as the prepayment cap instead of the essential capacity idea, which could work to protect vulnerable customers from sharp price signals or changes.

Whilst most accepted that in principle the idea should be beneficial for vulnerable customers, in reality every household will have a unique level of essential capacity, and introducing such a measure could cause a disbenefit for a customer that, for example, was reliant on a ventilator at home due to ill health.

There was consensus that if essential capacity were to be taken up, then industry should be at the heart of shaping such a tariff to avoid unintended consequences. For example, one attendee noted that a customer with very low usage could end up paying for their full essential capacity, even though they weren't using it.

What do suppliers need to deliver an 'essential capacity' charging methodology'

An independent supplier commented that they could theoretically offer a time of use tariff that varies on a second-by-second basis, so should be able to implement this. However, for the majority, metering and settlement is the sticking point for delivery of any time of use/capacity-based tariff. Suppliers will need to at least know half-hourly usage to estimate power drawn from the grid. This will require smart meters to be installed, and supplier IT systems to be able to settle demand on a half-hourly basis. It will be very difficult to charge on instantaneous capacity, as this would need much more granular metering and settlement, which is currently not available. However, it was commented that from the network's perspective, it is likely that half hourly would not be a problem.

Does this fit with how you see the energy world changing over the coming decade?

An independent supplier commented that the idea of essential capacity seemed to be predicated on the old world without electric vehicles, intermittent renewables or demand side response. The new world will need an increasing amount of flexibility in the energy system, and an essential capacity methodology will likely work to disincentivise flexibility within this capacity range. This seems to be at odds with the plan to get to net zero emissions. There was not a consensus on this, as some suppliers argued that there could be benefits for fuel poor households as they might be incentivised to use more energy where currently they underuse. Once again, the difficulties of ascribing an essential capacity that would work for all vulnerable customers was discussed but no conclusion was made.

Conclusions

There was a varied response to the idea of essential capacity, with some suppliers expressing that they could see the benefit for vulnerable customers, whilst others thought that it would be detrimental to achieving the smart, flexible energy system that we are looking to move towards, and that we should be looking to include as many customers in that system as possible, not just protect them. It was also noted that whilst it might be beneficial for some of the most vulnerable customers, others that have especially high capacity demands due to health conditions may see a disbenefit. Suppliers generally agreed that if such a mechanism was implemented then they would be able to pass it through to customers, if smart metering and half-hourly settlement was in place.

Supplier Feedback – Regulatory Recommendations

As part of the SAVE project, SSEN commissioned DNV-GL and energy saving trust to author a report to outline the regulatory recommendations that should come out of the innovation work. The main recommendations from that report are:

- In future deployment of SAVE Methods (and any similar methods or solutions), DNOs should limit the methods to include only the assets required to deliver the method's objective;
- Where a particular asset or functionality is essential, DNOs should consider how this requirement is met in the most efficient manner;
- In accessing the benefits of energy efficiency and demand side response solutions (such as the SAVE methods) whilst satisfying licence requirements and maximising returns under RIIO (the current price control that Ofgem implements for networks), DNOs will always have to ensure that (1) a particular solution delivers net benefits to connected customers, and (2) the solution is delivered so that its potential benefits are maximised.

To get a broad range of views on these recommendations, SSEN decided that it would be useful to hold a workshop session with suppliers to: Obtain their views on the recommendations; and determine whether there were any conflicts with suppliers' own policy positions on such matters. This section explores the responses to these questions, and reaches some conclusions based on these responses.

Supplier Views on Regulatory Recommendations

There was agreement from suppliers that the recommendation 'any solution should deliver net benefits to customers' is correct, and that these benefits should be maximised. Several suppliers commented that there needs to be some thinking about what is defined as benefits, as this can include environmental and social benefits, as well as overall network cost.

There was broad agreement that under the current regulatory rules, DNOs need to contract with third parties to ensure that the best value is achieved for the customer. It was mentioned that for customers to compete in DSO markets, it is essential for there to be regular customer contact and a trusted relationship, which is potentially not something that the DSO can offer at this time. The third parties that would likely deliver such domestic measures, would need adequate funding to be able to do it. Therefore, markets should be set up to account for this, potentially with longer contracts.

There was agreement that energy efficiency should be able to play into DSO markets on a level playing field with flexibility, and one independent supplier suggested that municipally-owned/white-labelled suppliers could be well placed to deliver local domestic solutions to network constraints, as they generally have high concentrations of customers in geographical areas.

There was agreement from all that DSOs should be assessing what the cheapest solution to any constraint is, with flexibility, energy efficiency and traditional reinforcement methods all competing against each other.

Conclusions

Attendees generally agreed with the regulatory recommendations that had been made in the regulatory report, with no conflicts identified.

Summary of Conclusions

SSEN set up a workshop with suppliers to test the results of its SAVE project, asking questions to determine whether the actions taken in the innovation project could translate into a business as usual environment. A summary of the conclusions can be found in Table 2.

Topic	Question	Conclusions
Energy Efficiency	Does DNO investment in energy efficiency fit in with ECO?	ECO does not currently represent a scheme that could easily help to fund energy efficiency measures in constrained areas. However, the scheme is moving in the right direction with this, especially within the innovation strand, and there will be an opportunity in the next iteration of the scheme, ECO 4 which starts in 2022, to have a scheme which has a more whole systems focus.
	What could be done beyond ECO to ensure that investment in energy efficiency is beneficial in terms of DNO costs?	Several other schemes across GB included government-funded schemes in Wales and Scotland. Smaller, more localised schemes in England may be useful from a Network context, but funding is much of a much smaller scale.
Price Signals	Do you agree that price signals can be an effective way of changing the shape of demand?	Attendees generally agreed that price signals can be an effective driver in the right conditions, and there is some empirical evidence in real life tariffs that substantial reductions can be achieved. There was a consensus that automation of demand is key.
	How do you expect Time of Use Tariffs to look?	Time of use tariffs are likely to come in many shapes and sizes, but they will be constrained by customers' ability to deal with complexity.
	Are current supply market arrangements set up to facilitate a DNO-led price signal through a time of use tariff?	The market arrangements are already in place to facilitate time of use tariffs, but smart meters, half-hourly settlement and sharp price signals will be required before they appear at scale. The outcome of Ofgem's network access and forward-looking charges SCR is therefore crucial.
Essential Capacity	Do you think that having an 'essential capacity' would be a good idea?	A varied response to the idea. Some believed it would help protect vulnerable customers, others that it would exclude them from the future smart energy world. It might be detrimental for some vulnerable customers that have high capacity demands due to medical conditions.
	What do suppliers need to be able to successfully implement such a charging mechanism?	Suppliers generally agreed that if such a mechanism was implemented then they would be able to pass it through to customers, if smart metering and half hourly settlement was in place.
	Does this generally fit with how you see the energy world changing over the coming decade?	A mixed view, where some felt it was incompatible in a world where we need to maximise the use of flexibility, whereas others felt it would provide much needed protection to customers.
Regulatory Recommendations	What are your views on the regulatory insights and recommendations?	Attendees generally agreed with the regulatory recommendations that had been made in the regulatory report, with no conflicts identified.
	Are there any conflicts of interest in suppliers also recommending these?	

Table 2 - Summary of Conclusions

NEA asked participants to fill out a feedback form, detailing how participants' knowledge had been affected by the workshop. The workshop had a positive impact on all measured knowledge areas, but particularly across the three areas of ‘The benefits of energy efficiency measures to managing grid constraints’, ‘DNOs social and fuel poverty-related support programmes’ and ‘SSEN's social and fuel poverty-related support programmes. Details can be found in Annexe 4,

Annex 1 – Invitation to the Workshop

SAVE

Solent Achieving Value from Efficiency

Scottish & Southern Electricity Networks

NEA Action for Warm Homes

SAVE THE DATE

Wednesday 8 May 2019, 9.30am-4.00pm
Coin Street Neighbourhood Centre
108 Stamford Street, London SE1 9NH

The innovative SAVE project was designed to quantify the relative value of using different domestic energy efficiency interventions that reduce or modify network demand to distribution networks.

Scottish and Southern Energy Networks (SSEN) and NEA now invite you to help shape the regulatory recommendations of SSEN's SAVE (Solent Achieving Value from Efficiency) project in the context of what its findings mean for suppliers.

Over the past four years through the SAVE project, SSEN have been robustly trialling the effectiveness of using in-home energy efficiency measures in the context of managing peak demand as an alternative to network reinforcement. Targeting domestic customers only, it has used monitoring technology alongside innovative approaches to engagement. Key successes have included achieving a statistically significant demand reduction through both installation and LEDs and influencing behaviour change through providing price signals at peak times. As the project is coming to an end, we would like to share some of the key insights from the project with you and understand how networks and suppliers can work together to take this innovation project into reality.

In the workshop, you will hear from SSEN on the real-life findings of the project and will be invited to contribute to the outputs by providing your own insights on the opportunities and barriers faced by suppliers in helping a network to deliver the benefits to consumers.

If you think that somebody else in your organisation would be better suited to attending please forward this invitation on.

To book your place click here

Annex 2 – Workshop Agenda

Scottish & Southern Electricity Networks
Supplier Workshop

Findings from the SAVE trials project

Wednesday 8 May 2019
Coin Street Neighbourhood Street, 108 Stamford St, Lambeth, London SE1 9NH

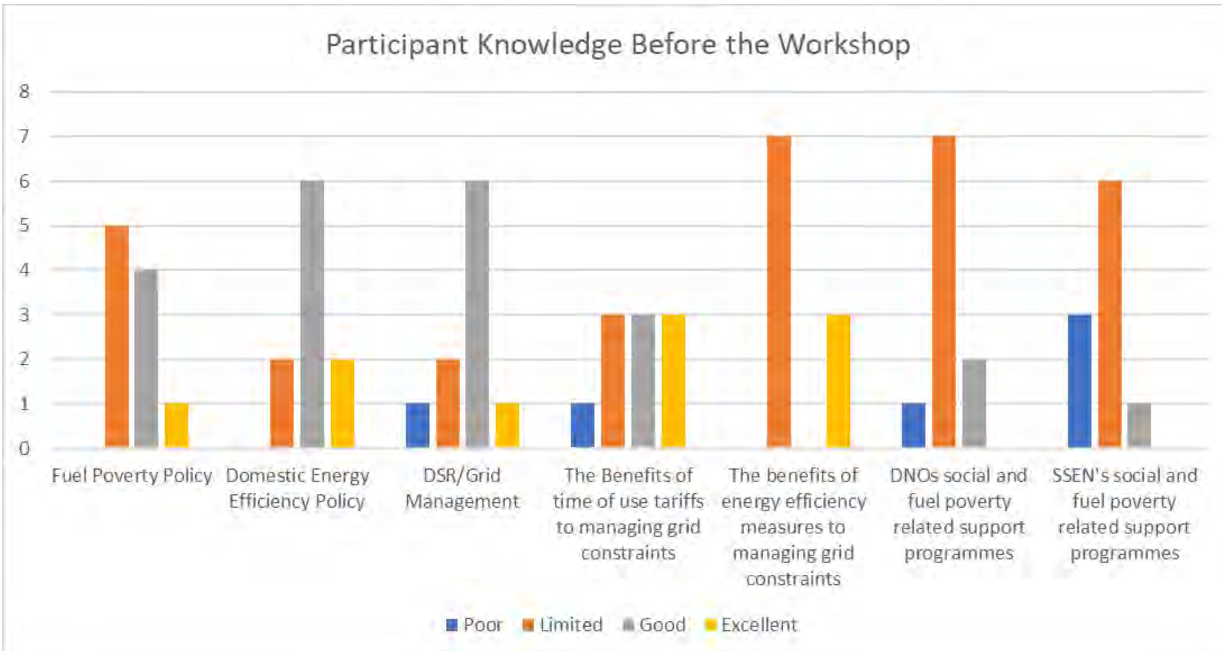
09:15	Arrival
09:45	Introductions ▪ Dörte Schneemann, Head of Markets for Flexibility, Department for Business, Energy and Industrial Strategy ▪ Peter Smith, Director of Policy and Research, NEA
10:15	Presentation ▪ Scottish and Southern Electricity Networks SAVE project trials
10:45	Workshop 1: SAVE trials project (ECO and dynamic pricing)
11:45	Coffee break
12:00	Presentations ▪ Core network capacity - James Kerr, Senior Policy Researcher, Citizens Advice ▪ SAVE project regulatory report – Elizabeth Steele, DNV GL
12:30	Workshop 2: Regulation in the context of the SAVE project
13:30	Networking lunch

Annex 3 – Table of Participants

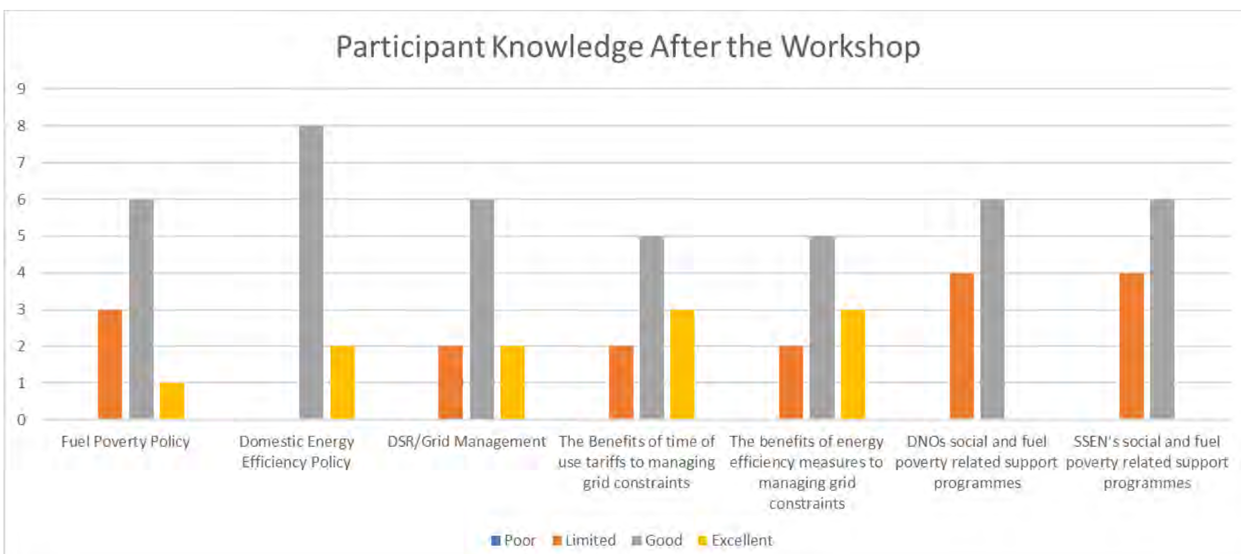
Organisation	Type	Presenter?	Participant?
SSEN	Host	Yes	No
BEIS	Official	Yes	Yes
NEA	Host	Yes	No
Citizens Advice	Consumer Advocate	Yes	Yes
DNV-GL	Consultant	Yes	Yes
SSE Retail	Large Supplier	No	Yes
Npower	Large Supplier	No	Yes
EDF	Large Supplier	No	Yes
British Gas	Large Supplier	No	Yes
Octopus Energy	Independent Supplier	No	Yes
Robin Hood Energy	Independent Supplier	No	Yes
OVO Energy	Independent Supplier	No	Yes
Energy UK	Trade Association	No	Yes
The Association for Decentralised Energy	Trade Association	No	Yes
Ofgem	Official	No	Yes

Annex 4 – Participant Feedback

Participants were asked at the end of the day, for several topics "How would you rate your knowledge of each of the following before you attended today's event" The cumulative answers can be found in the chart below



Participants were then asked "How would you rate your knowledge of each of the following after you attended today's event? The cumulative answers can be found in the chart below



Appendix 4.3 DNO Dynamic Pricing

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Ofgem Direction

Vulnerable customers are core concern with dynamic pricing

- How do negative implications of current system change/shift

Would be good to see what customers buy into specific schemes, uptake levels and resultant impact

Like measures that are 'carrot only' as opposed 'carrot and stick'

- Sits more comfortably with consumer groups

Consultation responses

More DNO relevant, more difficult to communicate

Baselining challenges + subject to gaming

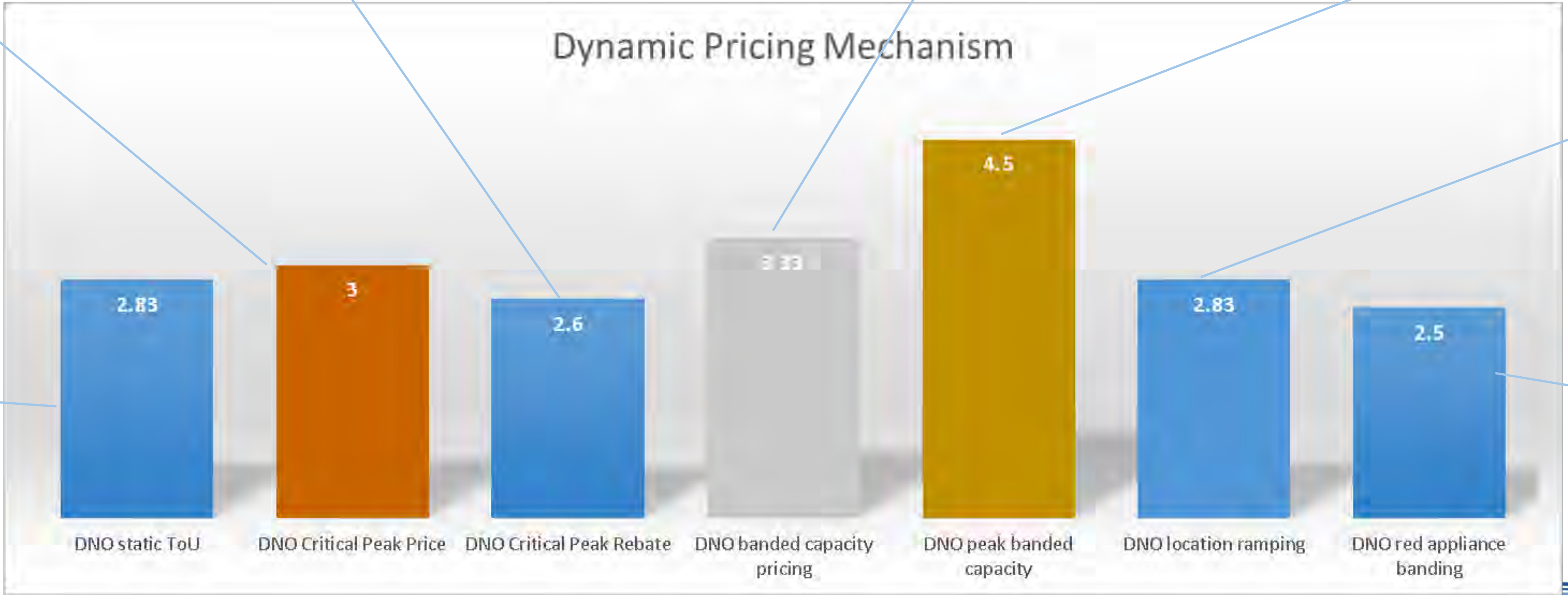
Similar to current DuOS charging
Must be reflective of heating types
Treats consumption at peak and off-peak same

Same as last but easier to accommodate off-peak loads (heating)
Particularly interesting with EV's

Similar to I&C DSR
Complex
New technology likely beneficial

Weekday/week end
Seasonality
Good for customers, not DNO

Logistically challenging



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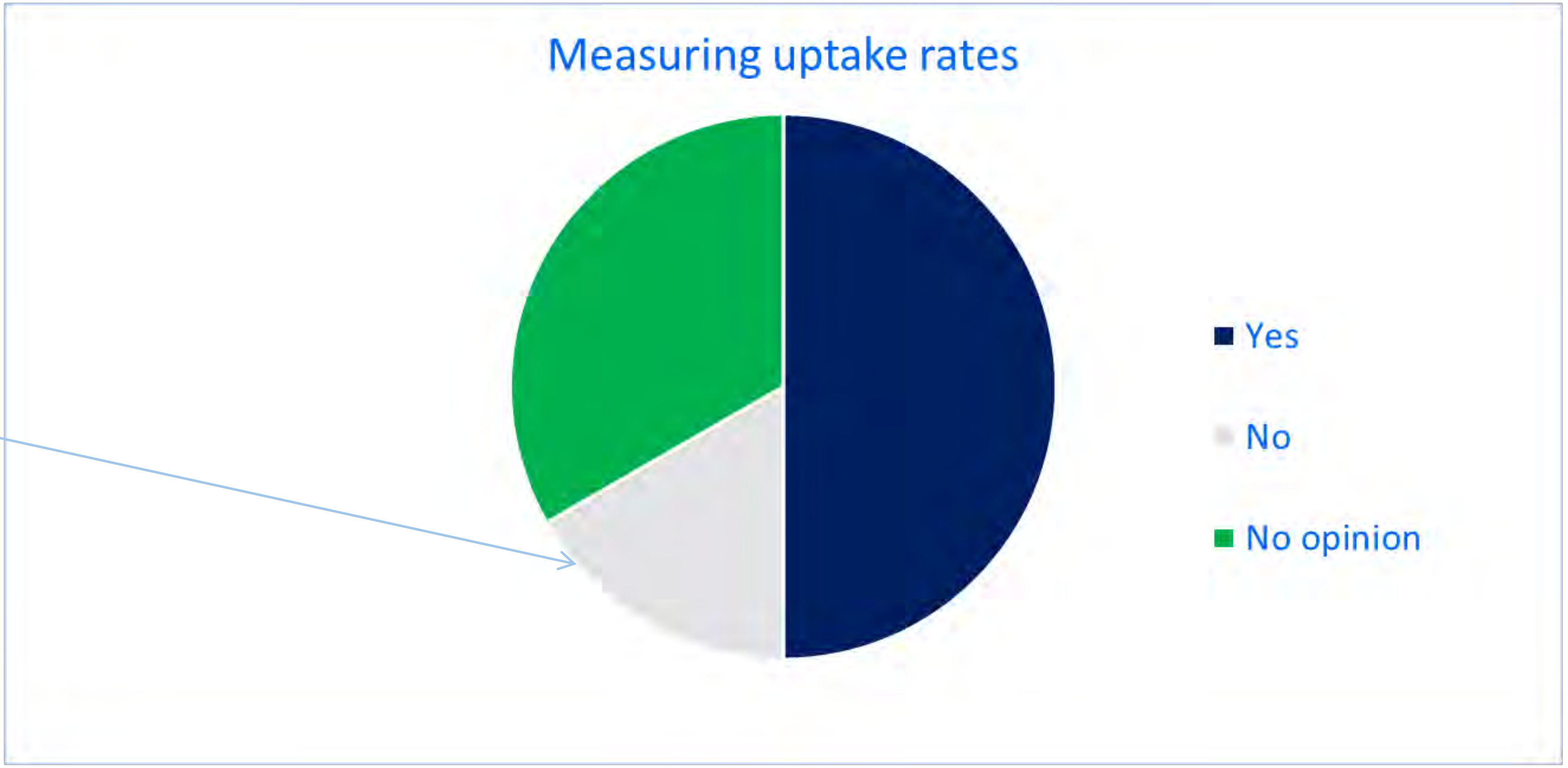
If SAVE could offer customers a range of the above pricing structures to measure uptake levels, with the caveat that this may mitigate the outcomes with regards statistical significance of the any customer interaction, would it be more useful and replicable to understand price signal attractiveness and uptake rates as opposed a mandated price structure (more common of previous trials)?

Too many tariffs will allow customers to pick an option that best suits existing behaviour- benefits only achieved if people change



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Project Direction

1. Pricing mechanisms to be looked at from DNO perspective as opposed supplier/other
    a) Mechanisms therefore incentive based- no need to trial disincentive
2. Project would like to run price signals on TG2 and TG3
    a) Intention is we vary price level not mechanism
3. Banded peak pricing recommended
    a) Consistent with 4to8 message (must consider heating type)
4. Project would like to test uptake of a given pricing structure
    a) Could be one structure or multiple
    b) Customers who don't sign-up could be rolled onto default mechanism
5. Project should try and determine separately the impacts on vulnerable customers

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Appendix 6- Business Case

1 TRIAL BUSINESS CASE ASSESSMENT - OUTLINE

1.1 Executive Summary

This section presents an overall business case assessment of the SAVE project. 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 section 1.4 below 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 Energy 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 was calculated at over £150m for SSEN southern patch scale, and nearly £1.5b for the whole of the UK. Meanwhile calculations for the Price Signal intervention show a NPV over £420m for SSEN southern patch, and nearly £4b for UK wide roll out. Waterfall charts for LEDs (Figure 1) and Price Signals (Figure 2) show summaries of the costs and benefits if these programmes were rolled out to the entire UK.

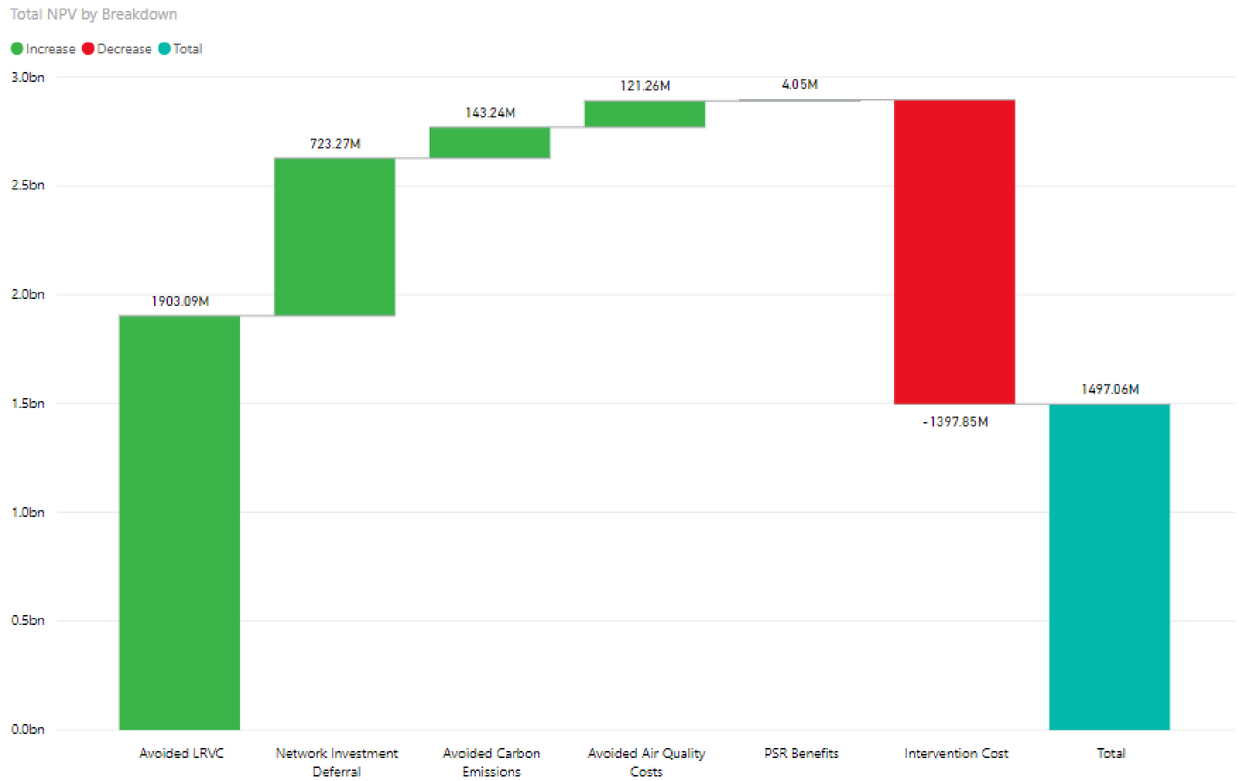

Figure 1 - CBA Breakdown - LED intervention - UK wide implementation (£m 2019)

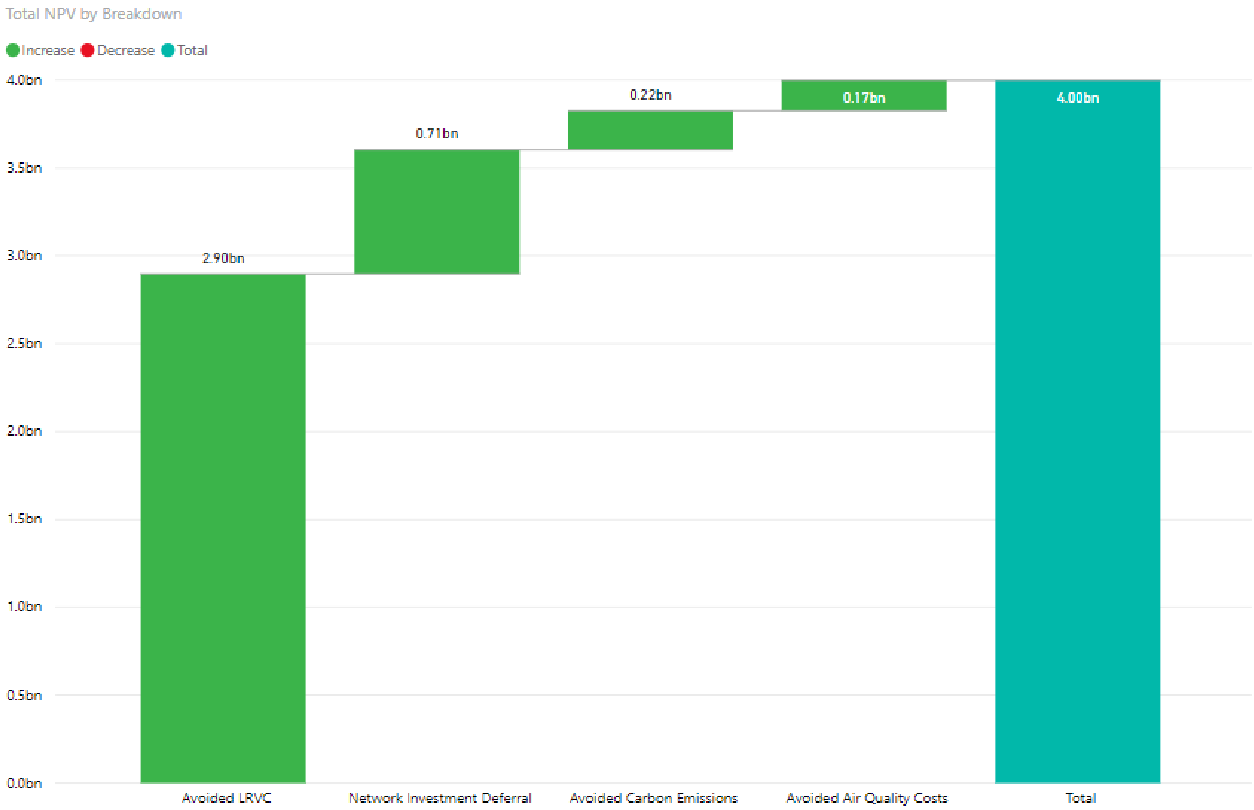

Figure 2 - CBA breakdown - Price Signals – UK-wide implementation (£b 2019)

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 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 this report believes their potential implementation should be pursued.

1.2 Introduction

The SAVE project aimed to robustly investigate the potential peak demand reduction of a diverse range of energy efficiency measures, as alternatives to traditional network reinforcement. Directed at residential properties, the exploratory research project assessed the effectiveness of differing interventions in relation to the extent of achievable peak load reduction and cost efficiencies.

The following business case assessment analyses intervention specific costs and benefits. These findings are based upon the initial bid submission, subsequent amendments, and research data collected throughout the project. For each intervention, quantitative and qualitative analysis is included to provide a comprehensive assessment of its overall effectiveness. The quantitative analysis considers the potential net benefits of deployment of SAVE interventions under business-as-usual (BAU) circumstances out to 2050, both at the scale of SSEN's southern network area, as well as in the whole of the UK. The detailed analysis provided for each intervention within the business assessment allows objective evaluation and comparison between the different interventions and their potential cost.

The intrinsic value of the SAVE project is the investigative findings of cost-effective ways in which DNOs can stimulate, through innovative methods, energy efficient behaviour to unlock cost efficiencies and environmental benefits. The primary purpose of SAVE has been to identify DNO interventions that provide maximum potential benefits for the UK energy industry and consumers.

The business case assessment examines each of the interventions trialled within the SAVE project. These are as follows:

- **Trial period 2 - LEDs:** this trial offered households free LED bulbs and installation (up to 10 bulbs per household).
- **Trial period 2 - Data Informed Engagement:** this trial provided households with energy saving education and invited them to participate in trial-designated usage reduction periods, known as 'events'.
- **Trial period 3 - Price Signals:** this trial implemented a banded price incentive. Households were provided financial incentives for each peak hour they managed to maintain their energy consumption below a custom threshold.
- **Community Energy Coaching:** the trial aimed to establish a sustainable legacy of environmental behaviour change through engaging directly with communities.

For additional details on trial design, please see SDRCs 8.3, 8.4/8.7 and 8.8.

For each intervention, the costs and benefits have been analysed for key stakeholders:

- Distribution Network Operator/Network, focusing on cost savings from reinforcement deferral; and
- Societal ("UK Plc"), including the value of avoided long run variable costs of energy supply, carbon reductions, avoided air quality damage and benefits associated with engagement of customers on the Priority Service Register (PSR).[1]

1.3 Original business case

The initial project bid to Ofgem included a high-level business case that illustrated the potential benefits SAVE might produce. Since inception in 2014, the SAVE Project business plan has evolved in terms of the actual benefits realised in trials.

The SAVE project has continued to provided updated business cases to Ofgem; a copy of SAVE's last reported business plan in June 2018 is shown in Table 1 and Table 2 below.

Table 1 SAVE business case 2018

Average annual household consumption (kWh per year)	4,226	4,226	4,226	4,226
	LEDs	Data informed engagement	DNO rebates	Community Coaching
Average annual household lighting consumption (kWh per year)	634			
Expected total reduction (%)	8.0	10	12	10
Expected annual reduction (kWh per year)	338	423	507	423

[1] As defined and valued in the government's supplementary guidance to the Treasury's Green Book at https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Expected hourly reduction (kWh)	0.04	0.05	0.06	0.05
Expected hourly reduction (Watts per hour)	39	48	58	48
Expected daily reduction (Watts per day)	463	193	232	193

Table 2 SAVE network applicability business case 2018

Small LV Urban	LEDs	Data informed engagement	DNO rebates	Community Coaching
Reduction on LV cable with 150 customers (kW)	6	7	9	7
Rating of circuit (kW)	200	200	200	200
Headroom made available (%)	2.89	3.62	4.34	3.62
Equivalent number of 3kW heat pumps or EVs now able to connect (without diversity)	**2**	**2**	**3**	**2**

Following final project analysis and reporting (available in SDRC 8.3 (LEDs); SDRC 8.4/8.7 (data informed and price signals); and SDRC 8.8 (Community Energy Coaching), updated value for energy and demand savings are available for each intervention. This section analyses business cases based the latest values available for each intervention.

1.4 Trial Outcomes

The achieved load reductions of each intervention form the basis of the business case analysis. All four of the interventions successfully achieved kW reductions and kWh savings, as shown in Table 3.

Table 3 Intervention Outcomes

	LEDs	Data informed engagement	Price Signals	Community Coaching
Peak load reductions per household (kW)	0.047	0.035	0.044	0.089
Annual savings per household (kWh)	90	0.42*	46.8	0.534*
Annual household energy bill savings (£)	£16.20	£0.08	£8.42	£0.10

** imputed values*

Table 3 shows the kW peak reduction and annualised kWh load reductions achieved by each intervention in SAVE. Annual kWh savings for Data Informed and Community Energy Coaching, whose focus was on load shifting during certain events, are imputed based on the number and duration of annual events.

The extent of savings and reduction varies significantly between interventions. As the nature of the interventions differ, the useful frequency of deployment also varies; this key factor distinguishes the LED and Price Signal interventions, which are deployed "continuously", from the Data Informed and Community Energy Coaching interventions, which are deployed based on a limited number of events in the year. For this reason, although the Community Energy Coaching intervention shows the highest realised kW peak load reduction (0.089), the infrequency of deployment results in low figures for annual kWh saved and, for reference, a notional annual energy bill saving[2] of £0.10. In contrast, LEDs and Price Signals realised lower

[2] Based on £0.18/kWh cost of electricity according to: BEIS, average annual domestic electricity bills by home and non-home supplier, 2019. Analytical approaches to CEC trials were not subject to the same level of rigour as the RCT approach of SAVE's other trials, for this reason a lower level of confidence can be given to these results

kW peak savings, but realised a higher kWh saving across the year, amounting to household energy bill savings of £16.2 and £8.42, respectively.

Given that Data Informed and Community Energy Coaching interventions focus on specific time frames to deliver load reductions, these solutions are most suitable as solutions to manage extreme network events such as those targeted by TRIADS. This contrasts with the LED and Price Signal interventions, which are designed as ongoing demand reduction/response solutions. Given the higher level of certainty around peak demand reduction for LED and price signal interventions we have undertaken an in-depth cost-benefit analysis to explore the economics of BAU rollout up to 2050 in Section 1.5. The evaluation of the Data Informed and Community Energy Coaching interventions follows a qualitative focus in the next sections.

1.4.1 Data Informed

The Data Informed intervention examined the effectiveness of reducing household energy consumption during winter peak periods via targeting treatment groups with energy saving advice and designated consumption reduction periods ('events'). The trial sought to identify the optimal methods of engagement for different customer types. The engagement material, delivered through a range of mediums (text, email, video and physical leaflets), encouraged households to either shift or reduce their consumption during specific peak periods.

The SAVE trial demonstrated peak load reductions of 0.035kW per household. Assuming a potential frequency of 6 trials over a year, i.e. one event a month during the 6-month winter period, estimated annual kWh savings would amount to 0.42kWh/annum. The cost of implementing the intervention consists of £24,010 in design and production costs, in addition to £6.06 per household that includes printing, packing, posting and the digital costs of the engagement materials. For reference, deployed in SSEN's Southern network area for single year on this basis, the Data Informed intervention could deliver £138k in savings on long-run variable costs of energy supply, £5.4k in avoided carbon emissions, and £6.5k in avoiding negative health outcomes associated with bad air quality.[3]

The SAVE project has identified various qualitative benefits that can be attributed to the trial's implementation. The benefits revolve around research accumulation and the dispersal of energy saving knowledge.

One such example is the insights gained around consumers' lack of familiarity with the concept of 'peak-hours'. Not only did the intervention address this knowledge gap by providing engagement materials to participants within the trial, but the discovery of this insight allows future projects or initiatives to direct resources towards the issue. Managing peak load is a key issue for DNOs and the insight of a lack of consumer knowledge in this area highlights the need for DNOs to realise further consumer education.

Another key area of benefit, and the integral aim of the intervention, is the learning gained on the effectiveness of differing engagement methods. The insight gained, specifically that postal communication is more effective than alternative methods, can help direct consumer engagement in future energy and environmental projects, ensuring their effectiveness.

1.4.2 Community Energy Coaching

In contrast to the individual household focus of the other SAVE interventions, the Community Energy Coaching trials focused on reducing energy consumption at the community level. Through engaging with communities directly, the trial evaluated the potential of continuous engagement and behavioural change

[3] As defined and valued in the government's supplementary guidance to the Treasury's Green Book.

techniques. An integral vision of the intervention consisted of establishing a sustainable legacy of energy behaviour change within the community.

The evaluation of the intervention centred on the collection of the energy consumption data of two different substations within SSEN's network area, each with approximately 1,000 households.[4] In addition, the project used surveys to establish the local engagement with the trial and opinions towards the differing engagement techniques.

The essence of the Community Energy Coaching intervention implies almost continuous engagement with the community is necessary. As part of the engagement communities were invited to reduce their demand during designated one-hour event periods. As with the Data Informed intervention, the incident-based deployment of the intervention requires realistic assumed trial frequencies. In this instance the analysis is based upon conducting six, one-hour events over a year.

Using these assumptions, a 0.089kW peak load reduction per household was calculated; the highest of any intervention deployed in SAVE. However, due to the infrequent nature of the events, the corresponding annualised savings are calculated to be 0.0534kWh per household. The cost of implementing the intervention consists of £7,000 in one-off set up and design costs, and a further £16.38 per household per year to deliver the coaching. For reference, deployed in SSEN's Southern network area for single year on this basis, the Community Energy Coaching intervention could deliver £165k in savings on long-run variable costs of energy supply, £6.9k in avoided carbon emissions, and £8.3k in avoiding negative health outcomes associated with bad air quality.[5]

The Community Energy Coaching intervention also uncovered various qualitative benefits. These benefits revolve around the primary objective of the trial: installing a positive sustainable legacy within local communities. The approach taken throughout the intervention involved prioritising a positive, community led campaign. This approach led to numerous neighbourhood-wide initiatives that successfully increased community cohesion and wellbeing. For example, the communities established a range of initiatives such as a walking bus, environmental clean-ups, community café, and increasingly promoted environmentally friendly transport methods.

These programmes highlight the increased energy and environmental awareness in the community. This awareness culminated in the co-creation of an 'Energy Literacy' toolkit. This clearly demonstrates the legacy of environmental awareness the intervention sought to implement.

Furthermore, the open and positive approach taken by the intervention provides additional benefits to the DNO. The association with the campaign produces increased consumer awareness of the DNO, as well as the role of the DNO in the energy chain. Increased awareness can help to build a positive public image for DNOs, which can be crucial to the implementation of future initiatives for DNOs to successfully deliver social and environmental outcomes with energy consumers.

1.5 Business as Usual Cost Benefit Analysis

The LED and Price Signal interventions provided the highest annual kWh savings, as well as being designed as "continuous" solutions whose benefits are not limited to uncertain and infrequent events. For this reason, these are considered the most valuable solutions for long-term implementation, a proposition evidenced in the following 2050 'Business-as-Usual' cost benefit analysis.

4 And two comparison areas, also with approximately 1,000 households each.

5 As defined and valued in the government's supplementary guidance to the Treasury's Green Book.

1.5.1 General considerations

The LED and Price Signal interventions can be utilised year-round and achieve considerable kWh annual savings. The LED intervention is calculated to achieve 0.047kW of load reduction and an annual savings of 90kWh per household. The Price Signal intervention is calculated to produce a load reduction of 0.044kW and annual savings of 46.8kWh.

The full business case assessment develops the findings of the SAVE project to represent households in SSEN's southern network patch (2,900,000), and all households in the UK (27,200,000).[6] The costs and benefits have been scaled up in accordance.

The following section introduces a broad overview of the benefits that have been calculated for the interventions within the business case analysis. The calculated benefits are apportioned into two distinct categories: network and societal benefits.

1.5.1.1 Network Benefits

The principal benefit to network operators unlocked by SAVE project interventions is the cost savings realised from being able to defer planned network reinforcements. We have calculated the potential benefits for SSEN's Southern area by adjusting the forecast load growth in the area for the peak load reductions realised in the LED and Price Signal interventions, to determine the potential postponement of planned investment at LV network level (principally planned investment in LV feeders and secondary substations) up to 2050.

Note that for the LED intervention, the timing and (household) location of LED deployment is optimised to enable the deferral of specific, planned reinforcements. In the Price Signal Method, it is assumed that the incentive is delivered to consumers not through explicit payments but through variable DUoS tariffs, akin to current tariff bands for half-hourly metered customers, where the differential between peak and off-peak charges delivers the price signal, to be passed on to consumers by electricity suppliers.

The total value of the benefit is calculated as the difference in net present value (NPV) of costs incurred under traditional reinforcement and reinforcement costs incurred when the intervention (LEDs and Price Signals, respectively) is deployed. The same analysis has been extrapolated to determine potential UK-wide benefits.

1.5.1.2 Societal Benefits

The Business Case Assessment considers additional societal benefits as set out in the government's supplementary guidance to the Treasury's Green Book for valuing energy usage and greenhouse gas emissions.[7] The key benefits from reduced electricity consumption covered include:

- avoided long-run variable costs (LRVC) of electricity supply (covering variable cost of electricity generation as well as transmission and distribution (T&D) costs);
- avoided carbon emissions; and
- the societal value of avoided adverse health impacts associated with bad air quality.[8]

The analysis calculates these benefits for the relevant kWh annual consumption reduction realised by the LED and Price Signals interventions, taking into account 8.2% average network losses (across transmission and distribution) based on June 2019 losses statistics referred to by National Grid ESO.[9]

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[6] Office of National Statistics 2018.

[7] Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[8] Values based on published figures from Public Health England and the Committee on the Medical Effects of Air Pollution.

A further societal benefit attainable from the SAVE intervention relates to engagement with customers on the Priority Service Register (PSR). Western Power Distribution (WPD) denotes these customers as requiring additional support and states there is significant societal benefit to actively engaging with the group. Using the quantified impacts of this engagement, as reported by WPD, the calculations for the LEDs intervention refer to engagement benefits with both existing (£1.20/household), and new (£1.10/household) PSR households.[10] The PSR benefit have not been applied to the Price Signals interventions.

For all of these benefits, the value is calculated as the NPV of the sum of benefits realised across all households in the area of assessment (SSEN's southern patch and UK wide).

1.5.2 LED

The LED intervention centred on the electricity demand reduction realised by LED bulbs replacing alternative lighting, such as incandescent, halogen and compact fluorescent. The intervention also sought to increase the prevalence of LED lightbulbs in households.

This intervention, in comparison to the other interventions, provides permanent demand reduction during peak and off-peak periods, all year round. This benefit persists even after the conclusion of the trial. While this intervention requires a high initial-roll-out cost, this is followed by no additional household engagement and therefore no additional expenditure. In accordance with established market rates, the cost benefit analysis assumes a one-off fixed cost of £81 per participating household.[11] After the initial provision and installation of LEDs by DNOs, the households are assumed to replace LED lightbulbs at end of life up to 2050.

When implemented at the scale of SSEN southern patch or the entire UK, the cost benefit analysis shows the LED intervention to be highly cost-efficient. The intervention yields a positive NPV of over £150m when implemented at the scale of SSEN's Southern network area, and nearly £1.5b for the whole of the UK. Figure 3 and Figure 4 provide a complete breakdown of the overall NPV.

The results show that the greatest benefit realised through the LED intervention is in the long-run variable cost of electricity supply. For the SSEN southern patch, this benefit amounts to £188m of benefits; at UK level, the corresponding figure is nearly £2b.

Furthermore, the demand reduction allows the DNO to defer reinforcement of the network. The NPV of benefits of deferred network reinforcement attributable to the intervention amount to £71m across SSEN's southern patch and over £720m UK-wide.

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[9] https://www.nationalgrideso.com/document/144711/download

[10] From Western Power Distribution's Ofgem Stakeholder Engagement & Consumer Vulnerability Incentive Part Three Submission: Consumer Vulnerability Outcomes. Regulatory year 2017/18.

[11] Based on a recent quote to SSEN.

Figure 3 – CBA Breakdown - LED intervention - SSEN southern patch (£m 2019)

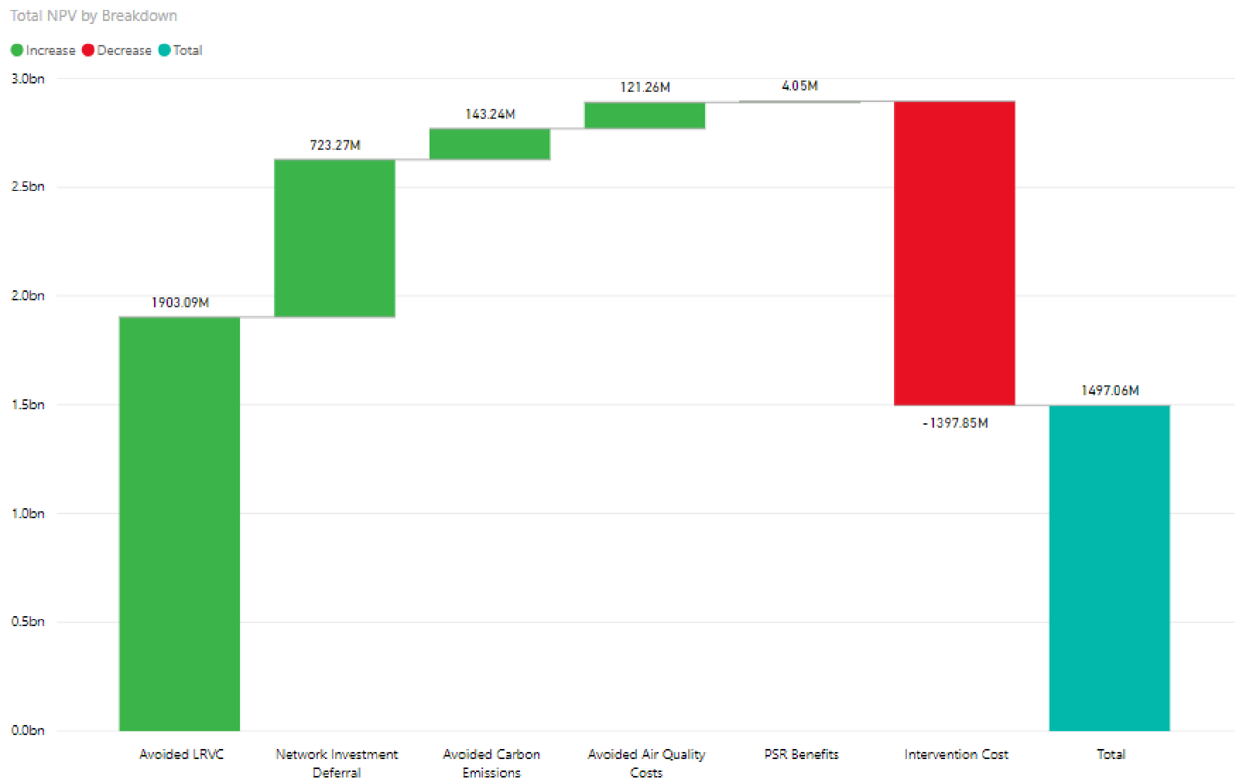


Figure 4 - CBA Breakdown - LED intervention - UK wide implementation (£m 2019)

Another societal benefit is reduced carbon emissions, which amount to £14m for SSEN's southern patch, and to over £143m across the UK. The intervention also provides air quality improvements from reduced generation. The quantified benefit to society is calculated at nearly £12m for the SSEN southern patch, and over £121m across the UK. The LED intervention helped engage with existing and new PSR households. Engaging with these households provides numerous benefits, and these can be calculated at £400k for the SSEN southern patch, and over £4m across the UK.

The LED intervention demonstrates a cost-efficient DNO led project that, through directly engaging with customers, provides various cost efficiencies and social benefits. The intervention when scaled up provides a load reduction that can help manage network demand, assist in future network investment strategies and provide numerous societal benefits.

1.5.2.1 Potential Cost Synergies

Although SAVE has not explicitly tested the potential cost synergies, we consider that there is potential to further increase the benefits of the LED intervention if cost synergies could be realised in the delivery of the intervention. For instance, a DNO could coordinate site visits with other utilities to deliver multiple services simultaneously, saving on time and labour costs. Water companies already provide water saving devices to their customers, such as low-flow shower heads or faucet aerators. Home installation visits maximise the savings of these technologies, and the training required to install LEDs and water saving devices could be combined. Installers could easily be trained to safely install both. DNOs should explore opportunities to partner with other stakeholders where the potential for collaboration exists.

We have carried out a reference calculation based on the assumption that the one-off costs for households to deliver LEDs, based on a joint-utility approach, would equal £36.30 (down from £81). This analysis shows that the total NPV for SSEN's southern patch could increase from £150m to £225m. At UK-wide level, the total NPV could increase from £1.5bn to around £2.3bn. This analysis demonstrates the potential for significant further gains if utilities would take a more holistic approach to service delivery.

1.5.3 Price Signals

The Price Signals intervention tested an incentive payment to encourage households to keep their consumption below a custom threshold during peak periods. Households were paid a fixed amount for every hour they succeeded.

In assessing the costs and benefits of BAU deployment of Price Signals up to 2050, we have assumed the incentive is delivered through variable DUoS charges, meaning that all connected households would be exposed to the incentive. The cost-benefit analysis shows an NPV of over £420m when implemented across SSEN's southern patch, and nearly £4bn when deployed UK-wide. A detailed breakdown of the figures is shown in Figure 5 and Figure 6, respectively.

As with LEDs, The biggest single benefit realised in the deployment of Price Signals relates to avoided LRVC of electricity supply, amounting to a net benefit of £308m for deployment across SSEN's southern patch, and £3bn when implemented across the whole of the UK.

The attributed load reduction also allows the DNO to defer network reinforcement. The value of this investment deferral is calculated at £70m for SSEN's southern patch, and £700m for the whole of the UK.

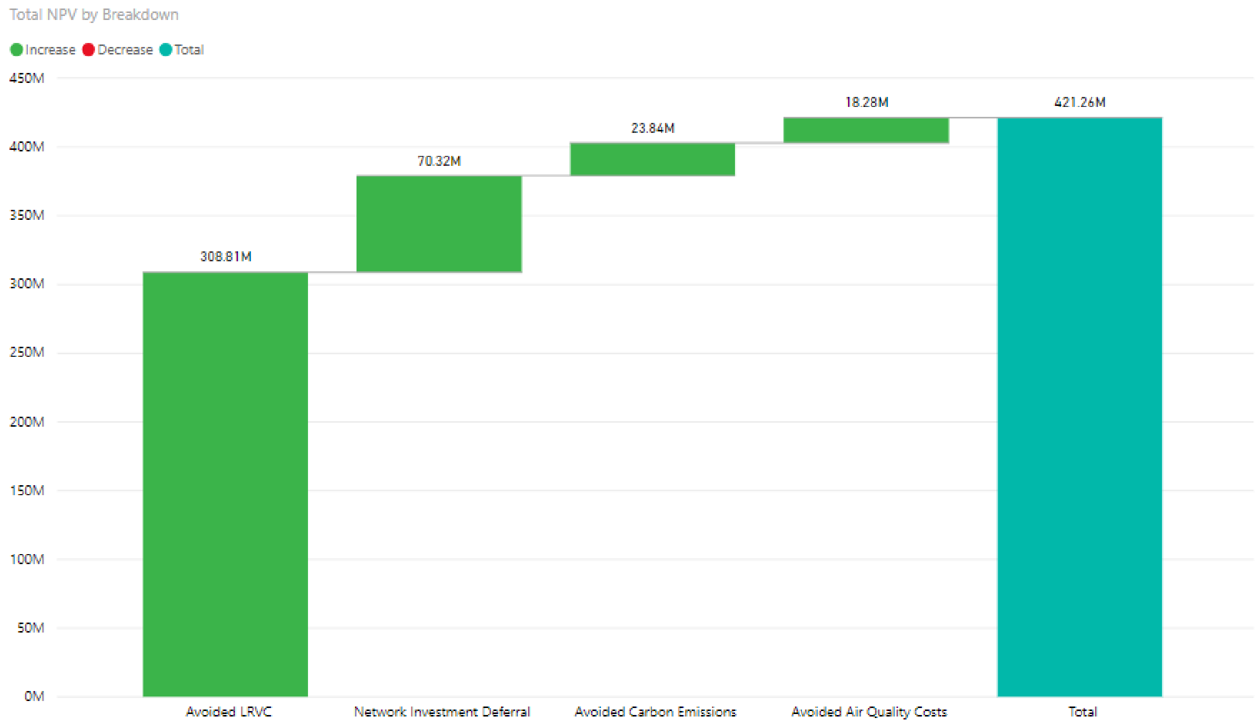


Figure 5 - CBA breakdown - Price Signals - SSEN southern patch (£m 2019)

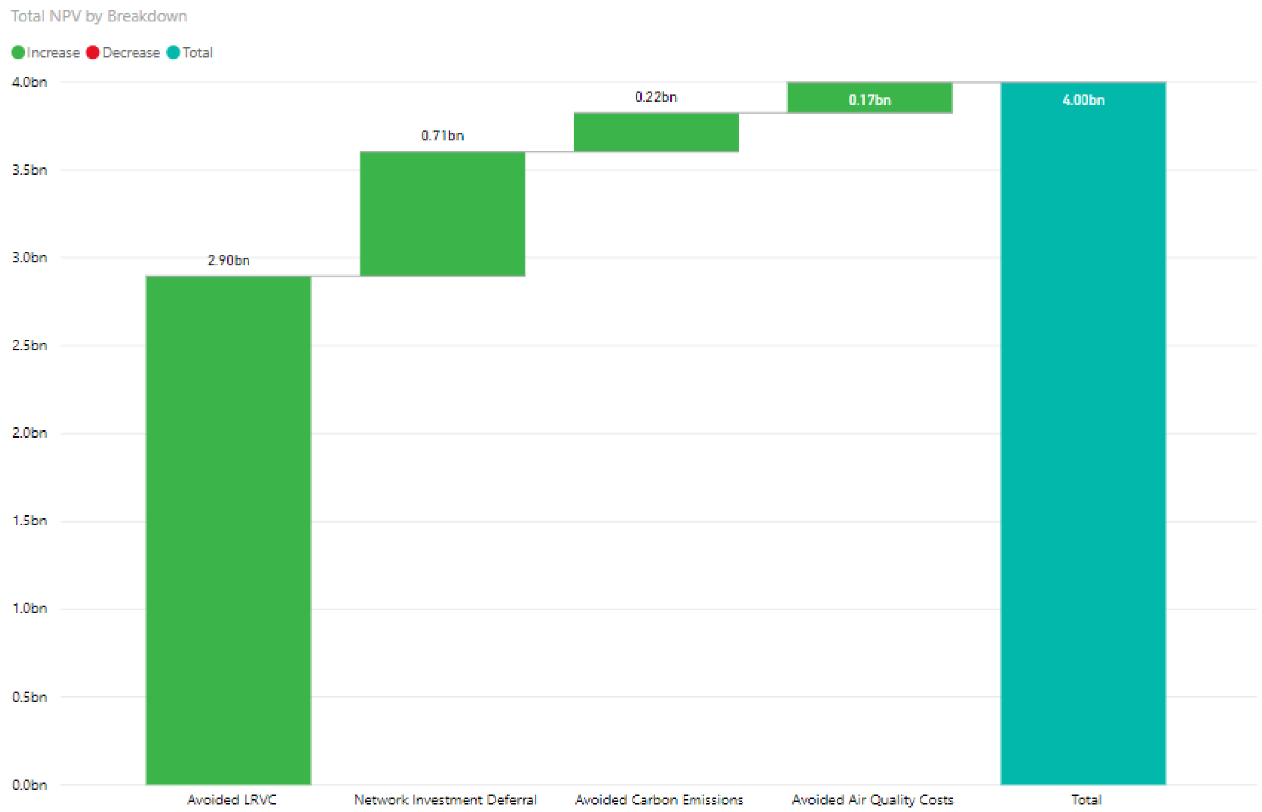


Figure 6 - CBA breakdown - Price Signals – UK-wide (£b 2019)

Reduced peak demand instigated by the intervention produces a significant reduction in carbon emissions, which can be valued at £24m for the scale of SSEN southern patch, and £220m for the whole of the UK.

The intervention also produces air quality improvements of £18m across the southern patch, and £170m if the intervention were scaled across the UK.

1.5.4 Conclusions

The SAVE project successful explored a range of innovative DNO-led strategies intended to manage load demand. All interventions successfully reduced household (peak) demand, although with varying degrees of efficiency. All interventions have the potential to provide substantial benefits to both network operators and consumers. The infrequent deployment of Community Energy Coaching and Data Informed with a limited number of yearly events generates comparatively low annual kWh savings when compared to LEDs and Price Signals. These interventions will be most useful on networks with relatively infrequent but predictable peaks.

Whilst Community Energy Coaching and Data informed have low kWh savings, they both have generated valuable qualitative outcomes. A key achievement for Data Informed Engagement is that it has led to greater consumer awareness of the concepts of peak load and peak periods, and the reason DNOs' efforts to manage peak load are key to realise cost-efficiencies and environmental benefits. Data Informed Engagement has also provided insight into methods of consumer engagement, proving that engagement via post is most effective in getting a message across to consumers.

Greater consumer awareness could increase consumer openness and responsiveness to energy efficiency measures. The Community Energy Coaching intervention has had a similar finding in confirming the merits of a community-based approach to enhancing awareness of energy efficient behaviour and environmental outcomes, whilst simultaneously realising other benefits from enhanced community cohesion and wellbeing.

The LED and Price Signal interventions generate both household peak load reductions as well as substantial demand reductions across the year. The 2050 business case assessments have shown a great potential value in rolling out the LED and Price Signal interventions on an increased scale as long-term, BAU solutions:

- When implemented at the scale of SSEN southern patch or the UK, the LED intervention can deliver a potential £150m of net benefits, rising to a potential £1.5bn when implemented UK-wide, up to 2050. These benefits could increase by another 50% if cost synergies could be realised through collaboration with other utilities, such as water companies.
- Price Signals could deliver a net benefit of £420m when implemented across SSEN's southern patch between 2020 and 2050, and nearly £4bn when deployed UK-wide. These benefits could increase if, through financial incentives households could be moved to optimise home heating (where electrified) and EV charging away from peak periods.

The business case assessment has shown that all interventions provide significant network and societal benefits. The most important area of success of SAVE is in the comparative assessment of the interventions, confirming that different interventions, because of the way they are delivered, unlock different benefits. The event-based nature of the Data Informed and Community Energy Coaching interventions may lead to comparatively lower quantifiable benefits, but do create a strong social outcome in enhanced awareness and changing the energy mindset of consumers.

While SAVE tested its' interventions independently, deploying multiple interventions with the same group is also possible and may lead to lower costs and/or greater benefits. These have not been explored in detail, as the impact of multiple interventions is not known (and they are not simply additive).

DNOs should consider implementing LEDs and Price Signals in to their BAU practice, as well as investigating opportunities for partnership that may result in even lower costs and therefore a more favourable business cases. Delivery of SAVE's initatives can support the goals of the UK's Carbon Plan and the transition to a low carbon economy.

Appendix 6- Part 2, Network Investment Tool Business Case

Executive Summary – for Inclusion in main body of report

The Network Investment Tool (NIT) is a complete, stand-alone piece of software that can be used by DNOs as part of their transition to being Distribution System Operators (DSOs). 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. However, 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.

Summary of Module Functionalities

The table 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.

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.

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 scneario, 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.

More detailed content – for appendix

The Single Assessment Module

The NIT's single assessment module allows network planners to understand current loading on a chosen network, and its distinguishing feature is the level of detail in the presentation of congestion problems. It highlights remaining capacity on a network as well as illustrating where thermal constraints are likely to materialise. It can, therefore, provide a complete solution to the needs of DNO connection teams, who are concerned with assessing available capacity for new connections. The functions of this module do not necessarily represent a significant change from software tools that are already in use by LV networks designers. However, the streamlined interface, the level of detail in the results, the reduced scope for human error and the flexibility in model specification make it attractive to DNOs, particularly as part of a single tool that offers completely new functionality.

The module's operation comprises of a user constructing a model of an LV network and the customers connected to it, using a clear yet complete representation in terms of nodes and branches. To save a considerable amount of time, users may reload previously built and stored network models. The constructed models are presented in schematic visual form for fast and easy verification. A load flow engine calculates the resulting patterns of voltages and thermal utilisations, and the results are presented in Excel table form. The user is free to re-format the tables to highlight whichever features are of greatest importance to them. With regard to allocating customers to network phases, the tool provides the user with a choice of manually allocating each customer, or to automatically match a phase imbalance target, which a user may possess as a result of substation monitoring.

Two load-flow engines are utilised by the module to conduct the necessary calculations. The majority are executed by the DEBUT engine, which has the advantages of: (i) already being widely used within the industry; (ii) being a relatively simple model with fast calculations; (iii) being based on probabilistic reasoning (as contained in the ACE 49 engineering recommendation), so that infrequent but plausible extremes, rather than mean values are used in the analysis. However, the DEBUT engine is unable to represent demand when net of embedded generation, and this is overcome with the use of the more computationally expensive EGD – a traditional (i.e. iteratively solved) load-flow engine that can account for generation. The calculations that necessitate its use are for over-voltages, i.e. the potentially problematic situations when demand is low and generation outputs are high.

The NIT provides the convenience of two levels of granularity for viewing the results of its load-flow analysis: per feeder and per network component (nodes for voltage results and branches for current/ thermal utilisation results). The user can also choose the season for which results are displayed, and whether they are for a weekday, Saturday or Sunday.

Several composite results are presented that would be very onerous to calculate manually. For the per-feeder resolution, the results presented are: the maximum transformer utilisation and the number of hours outside rating; the maximum feeder voltage drop; the number of customers receiving voltages outside of tolerance; and the length of feeder where the circuit loading exceeds critical limits. For the per network-component resolution, the results presented are: maximum current loads and when they occur; the number of half-hours per day for which branches are critically loaded; the highest and lowest voltages experienced by each node and the number of half-hours spent within critical loading limits. Finally, graphs are presented of substation loading during each of 48 half-hour periods across the day, for fast interpretation.

The tool allows users to define several critical voltage and thermal utilisation thresholds, and these define the criticality bands for those variables mentioned above – an excellent example of the tool's flexibility in response to varying analytical priorities. Other study parameters may also be tweaked to suit the user's needs, most notably a diversity weighting parameter, that changes the amount of diversity assumed in the precise timing of individual customers' peak demands.

Given that network monitoring is currently very rare at levels below secondary transformers, the high granularity of results presented by this Module (or existing, similar tools) are typically a network designer's only source of insight into issues that may be prevalent along the branches and nodes of an LV network. Even where monitoring data are available, the planner would have to somehow infer the risk of plausible but infrequent demand peaks from typically short periods of recorded data. The results calculated by this module on the other hand, represent extremes that would only occur on average once every 10 year, so that no extrapolation to extremes is requited by the designer. Any inaccuracies in the values produced by the model that may be inferred from monitoring data should be straightforward to correct by e.g. multiplying with some constant scaling factor and adding/ subtracting a constant.

The Future Assessment Module

The Future Assessment Module examines the year-by-year evolution of demand patterns for a single future demand and generation scenario. The module continues to present network congestion results to a high degree of granularity, but balances that with providing the user with a clear narrative of how congestion issues evolve over time. Most importantly, the user can choose to take mitigation actions – in the form of both traditional reinforcements and procured demand response services, and the tool presents in a detailed but clear way the impacts of these action across the years.

The future assessment module illustrates how loading on a given network may change over time under a given load growth scenario. This will be useful for network planners to study when, where and why a given network is expected to break. When conducted on many LV networks across the entire distribution network, this can feed into reinforcement planning and price control estimates, and allows a DSO to make more informed long-term investment decisions. Ultimately, the tool allows a network planner to more effectively and pro-actively target network management at those substations most likely to come under constraint in the medium-to long term

However, the more significant benefit of this module occurs when a DNO's network design team is aware that some form of intervention is necessary on a particular LV network – possibly as a result of analysis using the Single Assessment Module, or network monitoring, or customer complaints. In this case, the tool combines the Customer and Network Models to calculate the extent to which a chosen intervention, or set of interventions, would mitigate the increasing levels of congestion caused by the granular demand growth associated with a user-defined scenario. That is, the analytical abilities of the module allow designers to quickly and easily test the effectiveness, at a granular level of broad range of possible interventions, all within a single tool.

The full set of demand response and network reinforcement interventions that can be represented by this module (described in full in other sections of this report) are: (i) LED engagement; (ii) data-informed engagement; (iii) price signals; (iv) community energy coaching; (v) reinforcement of existing feeders, (vi) the splitting of an existing feeder, to create a new feeder; and (vii) replacing the transformer with a bigger one. (Installing battery storage is also an option included in the NIT, but this is handled by a stand-alone module). By including a range of interventions within the module, the planners are able to quickly assess whether any demand response options are able to compete with all possible forms of traditional reinforcement in terms of their precise overload mitigation abilities.

The Module makes use of many parameters stored by the Customer Model when calculating the effects of a chosen intervention, and the user benefits from the automatic use of these. These parameter values were calculated as a result of comprehensive statistical analysis on the unparalleled amount of raw demand data collected by the project, which provides the user confidence in their suitability. However, there are also many Customer Model parameters that the NIT user can adjust for themselves, so that they have almost complete freedom to construct the type of scenario they want. These additional parameters include: (i) erosion factors (per customer type) – capturing a gradual decline in the effectiveness of SAVE interventions over time; (ii) growth factor weightings (per customer type) – a desensitisation to energy growth or LCT growth parameters among e.g. small commercial enterprises, whose demand is relatively stable; (iii) the number of lightbulbs changed in a home visit (per customer type); (iv) the voltage and utilisation criticality thresholds, as for the Single Assessment Module.

As with the Single Assessment Module, the Future Assessment Module provides the user with a familiar Excel interface, and presents results in the form of re-formattable Excel tables. Results are again presented for the transformer, on a per-feeder basis, and if desired on an individual component basis. For the transformer-level analysis, the user is provided with summary tables presenting – potentially both with and without an intervention – measures of the severity of the thermal constraint on the target substation. Specifically, these are the maximum loading observed on the source

transformer, the maximum percentage overload and how long that overload lasts. The results presented at the per-feeder level includes the first year that an unacceptable voltage or loading condition is observed, the maximum and minimum voltage on a feeder within the study period, and the number of circuit nodes that have unacceptable voltages – as before, classified into user-defined criticality bands.
The module would therefore be of great use to network designers upon receipt of offers by external companies to provide demand reduction services, in that the impact and cost effectiveness of the proposed solutions could be assessed at this granular level.

It must be acknowledged that some of the information presented by the Future Assessment module could be gathered through other means, and processed into summary statistics and profiles. However, very significant development time would be required to produce another tool that can reproduce the level of detail provided by the NIT, which provides a very detailed and granular view about *exactly where* on a given network these issues may arise.

As previously stated, the value of the NIT is by no means limited to use with the Customer, Network and Pricing Models, plus the Census Interface in their current form, and the Future Assessment Module is no exception. For example, the Customer Model may expand to include heating types such as ground- and air-source heat pumps; or the Census Interface may be expanded to consider attributes such as the number of vehicles combined with the type of housing (flat, terraced, detached, semi-detached) to predict EV uptake.

The assessment of the relative attractiveness of smart solutions, i.e. those which are neither traditional reinforcements nor based on contracting demand reduction among LV customers is conducted by a dedicated sub-module. To date, this sub-module has only included interventions involving electrical energy storage. The module offers particular value by allowing customers to assess whether a storage installation can be used as an alternative to any of the solutions presented within the costing outputs, with the user again able to choose many parameters such as the maximum power output of one the storage unit in kW. This sub-module is particularly useful since it automatically assesses the suitability of a storage installation for each feeder within an LV network by using the interest earnt on the counterfactual investment for that feeder as a price ceiling.

The Multi-Assessment Module

The Multi-Assessment Module offers DNOs/DSOs a fully automated technical-economic assessment engine, that integrates the Network, Customer and Pricing Models in a sophisticated way to provide them with a new type of analysis. Indeed, this module is easily the one that represents the most novel offering to the DNO.

Like the Future Assessment Module, it provides a transferable and consistent mechanism for planning teams to gain a greater understanding as to how load growth, particularly LCT uptake on their networks, may affect loading over time. However, this model differs in that it allows the user to explore a number of *coherent strategies* for constructing sequences of interventions that tackle the constraints that arise from the load growth. Specifically, the module has developed three heuristic strategies that attempt to satisfy, for a given load growth scenario, all network constraints – as they arise – in an economically optimal manner. The measure of ultimate success for a strategy is to have the lowest possible Net Present Value (NPV) for the sum of all interventions, at the end of the period modelled by the scenario.

This tool offers another significant added benefit over the other modules: it explicitly considers the large uncertainty surrounding the nature and extent of load growth, by measuring the success of each strategy against a number (1 to 4) of load-growth scenarios. This allows a DNO to identify which interventions they need to be prepared to make under various future energy system pathways and, critically, when these interventions would be required. It also allows the DNO to react to uncertainty in growth forecasts and tailor investments to recognise this, instead of making significant investment choices on the basis of a single growth forecast which may not be realised.

The three strategies executed by the tool are called *flexibility maximum*, *flexibility maximum* and *all knowing*. The *all-knowing* investment strategy uses the Network Model to identify the minimum set of assets that should be built to have sufficient capacity to last from the year of the first overload until the end of the planning horizon, and does so with the benefit of full knowledge of the load-growth pathway. The *flexibility minimum* strategy is similar to the all-knowing strategy, except it only assumes complete foresight up until some user-selected network design date, with reactive interventions assumed after that. Only traditional reinforcements are considered. The *flexibility maximum* strategy takes the same approach as *flexibility minimum* with regard to the complete foresight up to some date, but differs in allowing SAVE plus storage interventions – so that comparing the cost of both strategies provides insight on the value of SAVE and storage interventions.

The highest level in the presentation of results for this Module provide the user with clear and useful information in the form of tables presenting NPVs for each scenario/strategy combination, and highlighting how the NVPs differ across strategies. The Module also offers the user more granular results, by listing the interventions and actions chosen by each strategy for each scenario. This provides network designers with a selection of possible step-by-step solutions to manage their network congestion under different scenarios.

The Multi-Assessment planning module maximises its value to users by allowing them to choose a range of global parameters covering both commercial and network parameters, but where default values may also be used for convenience. These parameters include the study's start and end years, the investment interest rate and the year at which the net present value of the costing evaluation results is to be assessed.

The Multi-Assessment module, like the Future Assessment Model, provides the user with great flexibility and precision when defining the individual scenarios. The adjustable parameters include the non-LCT load growth rate, LCT uptake rates, the size of individual LCTs, and LCT distribution weighting – which allows users to weight where LCT technologies are connected to the LV feeder, e.g. near or far from the source substation. Users are also able to adjust Pricing Model parameters, which include: (i) price signal success rates per customer type – how many respond at all; (ii) price signal elasticity curves per customer type; (iii) community coaching cost assumptions – fixed and variable setup costs, also fixed and variable ongoing costs; (iv) data-led engagement cost assumptions – again fixed and variable, setup and ongoing; (v) low energy light bulb cost assumptions; (vi) transformer replacement unit cost assumptions; and (vii) cable replacement cost assumptions.

Because the Multi-Assessment Module calculates results for many strategy and scenario combinations, it is inevitably less granular in its presentation of results for each combination. Further, in order to reduce the computational expense of calculations, the automated calculations of the Multi-Assessment module focus on the most problematic periods in terms of network constraints. As a result, network designers could use the Multi-Assessment and Future-Assessment tools together, in an iterative manner, and by doing so obtain greater value than is possible with either module by themselves. It is anticipated that where the Multi-Assessment Module shows opportunities to use SAVE interventions, this would be studied in more detail by running the future-scenario assessment, with and without that intervention, for that scenario in particular.

By running the intervention combination that a particular strategy generates through the Future Assessment Module, a network planner can use the wider range of network conditions considered by the Future Assessment module to verify that the investment decision is still technically valid. For example, it allows users to check the impact of SAVE interventions across all hours of the day, given for example the potential for these interventions to shift, rather than eliminate consumption. This iterative use of modules therefore offers the DNO confidence that the investments chosen by the

Multi-Assessment Module are reliable, along with insight into how exactly they resolve the congestion.

Perhaps the greatest value that the Multi-Assessment Module offers DNOs is the ability to create and maintain 'watch-lists' of the networks where interventions are most likely to be required in the future, allowing them to manage their resources optimally, including the scheduling of works. It is clear that multi-assessment reports can be used to form an investment 'watch list' for each LV network, that would warn network operators of when they are reaching a decision point for investment. However, carrying out this analysis across substations would also allow an overall watch list, either across their entire distribution network, or across regions within their network. This would not only assist with scheduling, but also allow network planners to better understand their expected capital expenditure on a year-by-year basis, improving financial forecasting for future price controls.

Rather than running these multi-scenario analyses once, and forever committing to the investment recommendations unreservedly, it is anticipated that this would be a live process where the Network Model was updated, on the basis of how exactly LCT demand growth (and other factors) have materialised. A live process of this type would result in changes to which feeders were on the 'watch list' and in some cases to the optimal choice of first interventions. Maintaining such a list could also enable a DNO to assess, with relatively minimal effort, changes to overall budget forecasts across the licence area in response to changes to economic factors such as interest rates, as well as social and political factors such as new government support schemes.

Another way in which the Multi-Assessment Module directly adds value specifically to SSEN, but could also add value to the other DNOs in the future, is by informing SSEN's assessment of whether so-called 'Constraint Management Zones' (CMZs), or Social Constraint Management Zones (SCMZs) might be viable solutions for specific LV networks. The CMZ concept, favoured by SSEN, looks to the market to provide a required level of flexibility (MW and MWh) across a pre-set availability window. Third parties providing solutions are incentivised based upon availability and utilisation payments, and flexibility providers will tender competitively to provide the flexibility services. SCMZs are SSEN's evolution of CMZ's, aiming to open flexibility market procurement to SMEs and local organisations.

The previously described watch list enabled by the Multiple Scenario Module could be extended to maintain a dynamic list of communities where the SCMZ concept could be deployed, by virtue of being close to LV assets appearing on the original intervention watch lists. Once identified, the DSO could pro-actively target and then engage with the communities to explain the benefits of participating in the modelled interventions.

This approach could help ensure that domestic DSR interventions were as successful as possible and maximise the social benefits of participation to customers and the wider UK. Indeed, the functionality which the NIT provides a network planning department is generally well orientated to aligning network planning activities with wider social benefits and Government targets, such as engaging vulnerable customers. This ability is enhanced by the fact that the Pricing Model already contains a vulnerability layer to identify and, if necessary, remove vulnerable customers from certain interventions (i.e. price signals that would result in a loss for those who don't shift.

Higher Voltage Levels

An additional HV/EHV module exists that allows users to analyse whether SAVE based interventions can provide a technical and economically feasible alternative to capital reinforcement of the HV or EHV system, when overloads are forecasted at those levels. This is an important question to be addressed by network planners, since constructing new 11kV/LV substations generally takes much longer than LV level reinforcements, and making reinforcements at HV and EHV level can take much longer. The ability to cast forwards in time to work out when new infrastructure would be justified, or more importantly if they can be avoided with demand side response procurement, is therefore particularly beneficial.

However, it must be acknowledged that this module is not able to provide fully comprehensive analysis at these higher voltage levels. For example, the module assumes that the HV or EHV planning engineer has already determined the firm capacity of the constraint and the forecast peak load to be supplied in future years. Here, “constraint” refers to a collection of substations which all contribute to a forecasted overload. It is also assumed that the designer has established the cheapest network led intervention that can resolve the constraint. Further, due to the very high level of potential complexity, the functionality of this module has been limited to dealing with network problems that are thermal loading problems under winter peak import conditions, that can be resolved to a radial simplification.

Appendix 7- SAVE Project lessons Learned

Category	Ref	Learning Captured	Influence on project thinking	Ranked value 1-5
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 were able to support this learning with the use of TU diaries in re-design to their analytical approach.	4
IT	2	The project team experienced issues in sharing files across multiple recipients. Especially with multiple contributing partners	A central SharePoint system was used to resolve this issue. Note it is important that such a SharePoint is easy to use, works effectively with multiple users and has sufficient capacity for the projects needs.	3
	3	Learning from SSEN's NTVV project noted that monitoring with synchronised time stamps can save significant work in pre-analysis formatting.	When tendering for equipment suppliers SSEN worked with UoS to understand the format of data being provided was suitable for analysis with minimal need for data manipulation.	3
	4	When offline, the Navetas loop will interpolate consumption across the period until communications are resumed, resulting in straight line consumption values for periods of data loss.	UoS implemented processing routines on the Navetas data to flag and remove interpolated observations, i.e. where consumption could not be attributed to specific periods.	3
Customer Engagement	5	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.	4
	6	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 meetings 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
	7	Discussions around disseminating information on SAVE (in particular to domestic customers) highlighted potential for trial spoil.[1]	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.	4
	8	**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.	5
	9	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.**	5

[1] 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.

	10	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.	4
	11	When running events with a large pool of customers to select from, late recruitment was actually seen as more effective than more pro-active engagement. Earlier engagement of participants often resulted in later drop-out due to double bookings or forgetting their commitment.	Following significant drop-out of attendees to the project's 9 focus group (see SDRC 3.2). BMG research supported a last-minute recruitment exercise with significant success.	3
	12	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)**	4
	13	**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.	4
	14	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.**	5
Energy Efficiency	15	When targeting customers to encourage uptake of a given technology (i.e. LED lighting) time should be spent ensuring websites are easy to navigate, clear and look professional.	Having identified this learning in TP1 the project worked closely with Navetas to test and tailor their website, ensuring it was clear and simple for use in TP2 and TP3.	3
	16	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 east 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.**	5
	17	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.	5
	18	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.	5
	19	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	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	5

		TG2.	proactive (TP2) trials has been built into the NIT and SAVE BaU plans (Section 9)	
	20	Within the LED pilot the project recorded a handful of incidences where field teams removed and replaced bulbs that were already LED's. Field teams should be trained to understand bulb types and to check the removed wattage of old bulbs	Further education was given to field teams post pilot and a logic applied to scripting to check the wattage of bulbs being removed.	3
Data Informed and Price Signals	21	Pre-monitoring analysis was used to reveal the most common appliances used at peak. This information was paired with appliances seen as easy to shift to support where messaging may get greatest results, namely: washing and drying activities alongside plug-in space heating.	SAVE's initial TP1 analysis for TG3 and TG4 focused around appliances/activities identified as easy to shift. This informed learning [34] from the CEC trials.	3
	22	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.	4
	23	It is important to consider messaging frequency. If too few messages are sent engagement is likely to be low. Likewise, too frequent messaging may lead to fatigue and disengagement.	Within TP1 a high frequency of initial messages over a short period of time led to some participant fatigue. In TP2 material was designed to be more practical (information pack as opposed to letters) and was spread over a longer period of time.	3
	24	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.	5
	25	Customers often need some prompting to save energy; treatment effects are generally highest after an email or postcard that reminds them about the 'ask'.	More mailers need to be sent out around event days to prompt load reduction.	2
	26	**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.	5
	27	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.**	4
	28	Text message notifications did not produce any peak reductions.	The results from this trial do not recommend using text as the main communication method.	3
	29	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.**	4
	30	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	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	4

		heat), and by households primarily heated electrically.	assess this alongside electrification of heating as this may increase the potential achievable load reduction from DDSR.	
	31	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.	5
	32	Building on [31] 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	
	33	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.**	5
CEC trials	34	SAVE's CEC trials identified that whilst the message of reducing electricity was familiar and known; the concept of shifting was a new concept for people.	When engaging communities, explaining the reasoning behind 'shift' messaging is key to aid understanding and is likely to reap more educational benefits than familiar 'cut' messaging	3
	35	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.	4
	36	The key, unifying driver for behaviour change in the consumption of electricity was the idea of being part of a collective aspiration for change	Messaging within the CEC trials was adapted to address this. Future energy efficiency and related environmental campaigns at the community level should focus on collective aspiration rather than individual / personal aspiration.	3
	37	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.**	5
	38	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.	4
	39	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.	5
	40	Engagement with stakeholders should take place at different levels within an	**Within the community coaching trials initial engagement with those in**	5

		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.	**strategic positions in organisations was important. Later in the trials engagement with more operational staff to support 'on-the-ground' was more important**	
Analysis	41	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.	5
	42	Despite robust trial design and recruitment, small but consistent asymmetries were observed in consumption between treatment and control groups, highlighting the importance of pre-intervention data collection to determine equivalence of treatment and control group and the need to plan for such outcomes in modelling strategies.	Statistical analysis implemented difference-in-differences models to control for asymmetries and was taken forward within the Customer Model. The impacts of using these models on trial design and implementation, data requirements and modelling strategies should be considered when designing future trials.	3
Customer Modelling	43	**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.	5
	44	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).	4
	45	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.	5
NIT	46	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.	4
	47	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 SCMZ's.	5
	48	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.	5

	49	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.	5
	50	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**	4
	51	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.**	5

Appendix 8- Project Replication Blueprints

Customer Recruitment/Engagement Replication Blueprint

Stage 1- Planning

1. Projects wanting to test interventions aimed at reducing consumption must consider sample size in order to robustly test the trial hypothesis and to avoid over or under recruiting participants. Whilst RCT's may be more costly, the outputs gained will give far greater certainty that observed effects are attributable to the intervention tested.
2. Rigour should be applied to ensure samples are representative of the population in question allowing scalability and replicability to findings.
3. Monitoring devices should undergo rigorous testing and potentially a pilot. This would include ease of install, HSE tests and battery life.
    a) As smart meter rollout increases the project acknowledges access to data/partnership with a supplier may offer less costly form of engagement. It may still be advantageous to augment socio-demographic and dwelling data to support further analysis.

Stage 2- Recruitment

1. Projects should carry out regular audits on field teams to ensure those recruited onto the project are experienced and trustworthy. Long-term contracts with field teams will also help maintain project relationships with customers.
2. Building on learning from UKPN's EnergyWise project, field teams with diverse cultural backgrounds can support in engaging minorities in particular.
3. Partner with a local organisation to build trust in recruitment (i.e. UoS).

Stage 3- Engagement

1. Customers should have one central contact point on the project with a guaranteed reply process. A robust CRM system could support this.
2. Field teams that are agile will be beneficial in responding to any unforeseen circumstances or drop-off in field comms.
3. Regular updates should be provided to customers to maintain engagement and support ongoing engagement.
    a) This should also look to prompt any updates to customer details i.e. contact details or change of address.
    b) As per learning from data-informed trials, letters sent out in pink envelopes may be more likely to be opened. A careful balance is also needed between engaging and not pestering households.
4. A project should have a regular report on status of field equipment, this may prompt an engagement mechanism which should be enacted swiftly in order to re-engage potential unengaged participants.
    a) It may be most cost-effective for this initially to take the form of letter, then phone and then (if cost-effective) a visit. Visits should look to be tied in with other exercises and should be geographically plotted to understand efficiency.

Stage 4- Decommission

1. Projects should start decommission discussions early in order for all partners to understand potential value from the field equipment post project.
2. Commercial discussions should be had around any potential ongoing value of assets with legal and GDPR requirements understood.
3. A cost-effective approach to decommission may look to initially allow customers to keep kit (if low value) or look to re-use kit. Only as a last resort/if kit is outdated should it be recycled in line with WEEE regulation.
4. Any process requiring kit from customers homes should (if kit is easy and safe to remove) first look to prompt customer removal through pre-paid postal engagement, supported by phone engagement and, as per 4a, as a last resort geographically mapped field visits

Business as Usual Costs

N/A depends upon process- competitive tenders should be run to identify appropriate field resource.

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)

Data Informed Engagement and Price Signal Replication Blueprint

Use case- For short-term and event-based winter evening peak load-reduction

1. In order to engage a target population through data informed engagement the delivery organisation needs to first identify an engagement strategy including: medium of engagement (email, text, postal), frequency of engagement, event based triggers and any CRM systems required.
2. Whilst e-mail and text engagement are likely to have lower Opex costs than postal engagement both these mechanisms will require some preliminary engagement in order to obtain appropriate consent and contact details.
    1. Postal engagement can be enacted more readily using DNO records of households and, where GDPR allows, will receive a greater response rate when addressed 'Dear Firstname Surname'. Postal notification could be used to reduce consumption during planned maintenance events or other issues that can be foreseen in advance.
    2. Email engagement however, due to its short leads-time, may be best suited to unplanned issues and could be used in post-fault situation when the DNO needs a reduction with little notice time.
3. It is suggested all communication utilises an opt-out methodology when engaging customers in order to maximise response
4. For price signal based interventions a DNO would require installation of domestic monitoring in order to determine load-reduction and deserved payment. See SAVE's regulatory report.
5. Likewise a delivery lead should frame how and when customers will be paid as well as any (customer) information required to achieve this.
6. For data informed based interventions a DNO would not require domestic monitoring, however some level of monitoring would be advantageous to assess schemes.
7. An exercise will then be required to create material which can meet a DNOs engagement strategy. SAVE would recommend this includes some level of education (energy literacy based on CEC trials) and items which may be retained in the home (sticky notes, stationary, magnets) as a priming exercise prior to 'event days' and prompts/information on energy saving actions.
    a) SAVE material is available on the SAVE website (www.save-project.co.uk). A user may wish to adapt this material or build it from scratch to deploy appropriate messaging. SAVE would recommend the use of behavioural techniques/expertise in order to maximise customer receptiveness.
8. Upon material creation customers should be engaged via the chosen delivery format(s) and inline with a delivery strategy and should be recorded in a CRM system.
9. Event based engagement should be pro-active to network needs and as a result should be easily deployable based upon 'triggers' (i.e. weather, faults, forecasting).
10. A feedback mechanism should be considered post events to report back to customers, if possible related to their contribution.
11. For price based methods a feedback mechanism would be crucial to ensure the correct level of payment is issued to customers. This should be recorded in any CRM systems.
12. For shift-based methods, the risk to the network of increased loads outside of periods targeted should be evaluated.

Business as Usual Costs

Data informed approach online: ((Cost of initial letters to customer + pre-paid return process) x no of customers) + Programme development costs + marketing costs + ((frequency of engagement x deployment mechanism) x no. of customers responding)

Data informed approach postal: Programme development costs + marketing costs + ((frequency of engagement x deployment mechanism) x no. of customers)

Price Signal Based Approach Postal: Programme development costs + marketing costs + (frequency of engagement x deployment mechanism + price signal) x no. of customers

Community Energy Coaching Replication Blueprint

Use case- For event-based winter evening peak load-reduction

1. Engage with local trusted organisations to establish the potential to recruit a 'coach' from an organisation already integrated/trusted within a community
2. Identify potential lead stakeholders who could support, be supported or be affected by your engagement programme i.e. utilities, local councils, housing associations, universities, RSC's.
3. Engage these stakeholders through industry forums, contacts and targeted engagement- make clear the benefit to that organisation of partnering and allow for flexibility in your strategy to recognise their benefits.
4. Establish and continue to build (and grow) a stakeholder forum, create a programme for regular meetings to stimulate collaboration and discuss: joint messaging, engagement programmes, overlap in activities, lessons and strategy.
5. Meanwhile coach to work on embedding themselves within a community, identify local groups, clubs and community champions (coaching principles can be read in appendix 1.4.1
6. Coaches should look to understand key drivers for the community offering support to help deliver local priorities and set-up regular catch-ups to support the community in addressing these. The coach should draw on the resources of the stakeholder group to support this where possible.
7. Coaches may like to build up a local brand for the community to help spread their reach for further engagement and enhance community owenrship
8. Coach to focus on building relationships, establishing a robust community group or building on an existing community group with clearly defined objectives to support the local area.
    a) Plans here must be flexible and may diverge somewhat between different communities dependant upon maturity of existing community structure.
    b) Given the vast array of engagement techniques which may be more/less influential in different communities it is advised key lessons learned from SDRC 8.8 are read and tailored to those being engaged.
9. Here coaches would start bringing in the message of a peak load reduction, testing messages around saving money, the environment as well as protecting 'your local substation' and the thought of being part of a collective community.
    a) There may be a need here for a degree of energy literacy (see appendix 7 in SDRC 8.8) and a series of engagement based events (supported by community leads)- concepts around efficient cooking are particularly effective as the draw of food can often be a usual catalyst for wider discussion
    b) Coaches may wish to consider engagement material designed and provided by stakeholder groups to support such engagement
10. Coaches should also work on integrating the message of load-reduction into the communities own drivers, for instance if litter was an issue, using the connection of the environment and then saving energy would be an obvious chain of thought.
11. Finally coaches should look to establish solid relationship within the community by building a clear strategy for ongoing change, this final stage is about allowing the community group to be self sustaining.
    a) This strategy should include any ongoing support from stakeholder groups and may be owner by either the community, stakeholders or both
12. It is once this process is complete and the stakeholders have both supported and educated the community they should look for load reduction.
    a) This can be tested through; habitual change supported by materials, ongoing qualitative feedback and bespoke 'critical peak' style events.

Business as Usual Costs

Annual cost of a community coach (3 days per week) x no. of years of engagement (3 years) + cost of community energy coaching PM/consultant + (cost of engagement material x no. of customers)

Note- Engagement material needed will likely vary from one community to the next based upon community maturity at point of engagement. It is expected a degree of engagement material costs should also be shared across wider stakeholders in the projects stakeholder group.

Network Investment Tool Replication Blueprint

1. Individual household electricity consumption data is required at a minimum of 30 minute granularity (i.e. smart meter data) pairing with demographic information would be required to provide input data to the customer model.
    a) SAVE did not gather data on SME and commercial customer data and so used existing industry profiles- future projects may also wish to obtain such profiles for their model.
    b) It is suggested data is gathered for at least 1 year to provide the ability to run a model across different seasons.
2. Future models may then wish to take SAVE's demographic categories to build customer load-profiles or would need to carry out analysis of household characteristics most strongly associated with variability in consumption.
3. Both the network model and the pricing model area bespoke software interfaces, in order to build this users may wish to build a 'wrapper' around an existing load-flow engine as SAVE has done with Debut. Model build is detailed fully in SDRC's 7.1, 7.2 and 7.3/8.5
4. In building either of these models a lead architect must decided what he would like to study, what data will be required to study 'said' outputs and the technical feasibility. This may be well placed being delivered in a series of visual schematics followed by a wireframe and then a functional specification.
5. In order to operate the current Network Model, users will need to build a geo-schematic of their network. This is currently performed by plotting customer postcodes onto GIS software of the network and uploading this to the network model. In future DNOs may look at software to automate this process through more advanced GIS referencing of their networks.
6. Customer profiles (from the existing customer model or bespoke data, gathered in step 1) must then be linked to different customer 'nodes' within the network mode. In order to accurately link the correct customer demographic profiles with nodes a census interface must be developed. The census interface links network data with census OA's and is described in section 3.2.2 of SDRC 8.5/8.6.
    a) This step will require access to census data which can be requested from ONS.
7. The user will then have a network on which they can model network loading based on the (season) of customer profiles loaded into the model.
8. Based upon the functional requirements defined the user should then test running a range of studies, scenarios and strategies on the network loading
    a) For SAVE this included the single scenario, future scenario and multi-scenario (see SDRC 8.5/6)
        i. Additional studies may require additional data i.e. load-growth scenarios, LCT profiles, reinforcement and smart intervention costs, smart intervention profiles (on a per household data if a DDSR trail- loaded into the model using the same step as: 6)
    b) Testing of these strategies should be trialled in sprints to support model development to time and budget
9. SAVE has also produced a manual on operation of the existing NIT to support users, it is recommended this is updated for future model iterations.

Business as Usual Costs

N/A highly dependant of software requirements and competitive tendering

DNOs should consider support packages needed in delivering software into BaU alongside cost of additional data inputs for instance to the customer model.

Appendix 9 SAVE Dissemination Exercises

Date	Event	Activity
5/14	Presentation at SmartGrid GB	Presentation providing overview of objectives, setup and trial design
5/14	Customer engagement "lessons learnt" workshop	Build on learning from other projects/initiatives
6/14	ECO technology show	Supported SSEPD stand and discussed project with stakeholders, providing general information and adding several to Stakeholder list
7/14	ECO Technology Show	Follow-up with head of PR and Social Media Strategy at SaveMoneyCutCarbon.com who wanted to disseminate Project objectives, with focus on Community Coaches, following the Eco Technology show
8/14	Presentation to DECC	Presented to 11 members of DECC (from Heat & Industry team and Science & Innovation team), providing overview of project, and adding attendees to stakeholder list
2/15	Outline of smart-plug usage within SAVE	Role of smart plug monitoring as part of overall domestic usage solution providing appliance specific data. Project Progress Report was circulated in December to provide broad spectrum update on the projects progress, both information streams to be used in update to Citizens Advice
11/16	NTVV DNO Roadshows	As part of NTVV roadshow presentations (including 4 events to 5 DNO's) it was discussed how LO's from NTVV were feeding into SAVE and a brief project overview was given
1/17	Utility Week Conference	Provided an overview of SAVE to a range of industry relevant professionals including DNO's
2/17	NTVV internal training	As part of NTVV internal training in which 6 events were held (4 in south, 2 in North) it was discussed how LO's from NTVV were feeding into SAVE and a brief project overview was given
3/17	Rough guide to engaging communities in energy network innovation	https://www.regensw.co.uk/rough-guide-to-engaging-communities-in-energy-network-innovation
4/17	DNO contacts	E-mails sent to key contacts (from NTVV DNO Roadshows) at each other DNO introducing SAVE and opportunities to build on their projects and share our learning.
4/17	Discussion with SSEN Smart Metering Programme	The SSEN Smart Metering team are looking to compile benefits across the DNO from smart meter data and at what level of granularity (i.e. no of readings a day, no. of households etc). The team have held three workshops between November 2016 and May 2017. Provided an intro to SAVE and the evidence that could be gathered from the project towards value of smart meter data, notably for DSR trials and issuing price signals

4/17	Correspondence with Association of Meter Operators (AMO)	PM contact with AMO to outline SAVE and issues associated with removal of Navetas Loop as a result of smart meter installs.
6/17	Provide understanding of SAVE project, specifically monitoring capabilities to BEIS	Full overview of SAVE project and introduction to modelling capabilities. Discussion around BEIS thoughts with regards heat maps of our network. This would allow modelling/targeting of EE in certain areas.
6/17	To make Network Planners aware of NIT and secure support	PM gave overview presentation of SAVE and project analyst introduced modelling aspects of project. Head of system planning noted need for usability. Response was positive, planners to support on project calls and give planning direction
6/17	Meeting with Lead Connection Design Engineer	Discussed value of network planning at LV and future proofing through smarter modelling and monitoring.
7/17	WholeSEM conference	WholeSEM is an EPSRC funded initiative concerned with state-of-the-art energy system modelling - particularly linking and integrating multidisciplinary energy models and applying them to key policy questions surrounding future energy system planning and development. Main points relevant to SAVE from the conference: 1. Chief Scientific Advisor to BEIS noted that use of modelling by BEIS is undergoing transformation which includes a focus on quality assurance and more involvement of third parties 2. There is a move away from large and overly complex ‘do-it-all’ models to better interlinking models 3. There is recognition of the critical role that flexibility plays in the configuration of the future UK power system (including domestic demand response specifically) – consequently there was much interest in the SAVE project from the participants 4. Interest was high in both the trial results and in the customer/network modelling 5. There is interest in dissemination and future scoping work with the modelling community (particularly members of the consortium) around how insights coming through SAVE can be integrated into key long term and system-scale modelling at appropriate spatial and temporal scales; for example, integrating with models such as the Whole electricity System Investment Model
7/17	Discussion with ENW around their proposed power saver plus project	PM discussed SAVE recruitment, trials and surveys. Follow-up discussed for June 2018 when would be possible to provide ENW update
7/17	Discussion with local MP in Southampton	Discussed project overview with particular focus to arranging a project visit with the project team. MP noted particular interest in CEC trials and events that may be attached to these.

8/17	Discussion around ACE with NPG	Overview of ACE project and GenGame, key LO's and overview of SAVE project and its key LO's to date
9/17	Meeting with Energy Saving Trust	PM gave a 40 min overview presentation on SAVE trials up until Sept. Follow-up group discussion around mutual areas of benefit. Specific interest in data available through NDA and SDRC 2.2. due Dec 17.
9/17	SSEN Future Networks Newsletter	Introduction to SAVE and preliminary findings around Sunday peak consumption to stakeholders signed up to SSEN's future networks newsletter.
10/17	Call for evidence on Energy Efficiency	Issued by BEIS, SSEN response drawing on learning from SAVE.
10/17	Discussion with Easy Smart Grid	This engagement came about as a result of dissemination in the future networks newsletter. PM gave a 20 min overview of SAVE and then discussed easy smart grids automated domestic DR products.
10/17	Reducing Building Energy Costs	Presentation on innovation portfolio, specific reference to SAVE including means of DNO engaging customer in future (case study LED trials)
11/17	Discussion with University of Bath on WPD Sola Bristol ToU tariffs	Telephone discussion- noted Sola Bristol ToU trailed with minimal customer interaction as enacted through an energy management system. Started with dynamic tariff changing every half hour- too complex so changed to a three-tier
11/17	SAVE Houses of Parliament event	Intro presentation on DSO given by SSEN Head of Future Networks. Labour Shadow Energy Minister discussed relevance of SAVE in evolving energy markets. SAVE overview by project partners and feed-in to industry given by PM.
11/17	UoS liveable cities event	Exhibition on UoS projects, SAVE poster displayed and networking- overlaps and learning discussed
2/18	CEC trials meeting with SSEN Network Engineers and customer relations teams	Meeting with teams to discuss their key objectives and overview of NEL key learnings
3/18	Seminar and Podcast on SAVE titled: "SAVE A large scale randomised control trial approach to testing domestic electricity consumption flexibility in the UK"	Overview of how electricity market and networks work, with SAVE used as an example of behaviour change https://www.nzwine.com/en/our-regions/central-otago/ https://www.r1.co.nz/podcasts
3/18	Presentation on SAVE at utility week conference	Presentation led by BMG research on recruitment elements of SAVE
3/18	Final Dissemination event with both trial communities	Focus group format event facilitated by independent facilitator to draw out opinions of residents across each community- formally reported in project folder

	and stakeholders. Event report circulated to attendees and stakeholders.	
4/18	Educational speech/video for Otaro University	Educate students and stakeholders on SAVE study approach and findings https://www.youtube.com/watch?v=xmjtClb9uG8
4/18	SAVE Open Days 7 and 8	Presentation to TG3 and TG4 participants by SAVE's PM to give overview of energy agenda. Interactive activities on 'your data' by UoS and focus group Q&A by 'Behaviour Change' on TP2 and plans for TP3
4/18	Network Planners Dissemination Roadshow	Overview of SAVE project learning, including LED lighting results and modelling approaches. Questionnaire to understand support in building NIT
5/18	Association of Local Energy Officers (ALEO) Spring Meeting	Presentation on energy storage and value that DNO led EE could bring to local councils.
6/18	Meeting with Citizens Advice Bureau	Presentation of SAVE, specifically learning around EE and ToU -Discussion of structure of CAB and targeted areas SAVE trials could work with
6/18	Follow-up meeting with Energy Saving Trust	Presentation of SAVE, specifically learning around EE and ToU -Overview of current EST projects, learning and opportunities
7/18	UKPN- EnergyWise Closedown	15 min presentation on key learning from SAVE and how they can build on EnergyWise
7/18	PRESAG annual meeting	UoS exhibited its work on energy at the PRESAG annual meeting 10 July 201. Supported by programme of twitter activity
7/18	Discuss BaU EE initiatives with Thames Water	Discussed SAVE findings, TW noted over 70,000 field visits per year on water efficiency and a chance to partner on an initiative
7/18	Discuss BaU EE initiative with SGN	SGN noted a range of EE and safety schemes they've run including green doctor
7/18	Meeting with GenGame	Update on ACE following closedown. Discussed potential to integrate GenGame with Loop
7/18	Meeting with UCL	UCL shared some work done with citizens advice and literature on price elasticities
7/18	Meeting with Citizens Advice Beurea	CA noted interest they were interested in EE initiative
7/18	Exhibition at the All-Party Parliamentary Group for Renewable and Sustainability Energy (PRASEG) Annual Conference	Poster sessions run by UoS at event in London

7/18	TWITTER campaign	Using SAVE data to estimate Electricity consumption in the UK during matches in 2018 World Cup.
8/18	Attended NZ Energy Network Association 'Network Transformation Roadmap' (NTR) Project	Briefing/teleconference - essentially, they are trying to re-imagine local distribution in a zero-carbon future. Roadmap to be published by October. LCFN was mentioned as a mechanism to emulate for R&D and SAVE as an example.
8/18	Meeting with Carbon Trust	Understand means of scaling, additional finance and moving to SME sector
8/18	Extended Leadership Team SAVE EE trials overview	Overview of SAVE EE trials and cross utility collaboration
8/18	Presentation to SSEN customer relationship managers (CRM's)	Overview of SAVE EE trials and cross utility collaboration
8/18	Presentation to SEPS LV planners on how SAVE EE trials could be rolled-out	Overview of SAVE EE trials and cross utility collaboration as well as site identification for such an initiative
8/18	Presentation to BRANZ (Building Research NZ), Wellington, NZ	Presentation hosted by UoS
8/18	Department of Economics Seminar, University of Otago	Presentation hosted by UoS
9/18	Discussion with PAMIS	PAMIS is charity who help people with profound and multiple learning disabilities, their families, carers and professionals. They are trying to encourage Occupational Therapists to engage more effectively with the groups they help and talking about the community couching working well struck a chord with Chief Executive of PAMIS who was especially interested in any outputs and learnings we can share for the community coaching aspect.
10/18	BEIS workshop on Energy Efficiency following their call to evidence	Provide government evidence of barriers and opportunities to EE. Facilitate engagement with others in EE spectrum- connections for SCMZ
11/18	Parliamentary event in HoP displaying SSEN innovations in exhibition format	SAVE presentation with banners in room in parliament to MP's in SSEN constituencies. Held with UoS, around 12 attendees
12/18	LCNI Conference	SAVE overview to DNO's + industry stakeholder. Including presentation given.

1/19	Energyst news article	News article providing an overview of SAVE outputs and how this is feeding into SSEN's SCMZ concept https://theenergyst.com/sse-networks-to-bring-households-into-demand-side-response/
2/19	SSEN Presentation at UoR 'DeepRed' project closedown event	Presentation to a room of around 50 from fields of academia, networks and customer focus groups
2/19	Green alliance community energy 2.0 panel session	Panel session discussing the role DNO's can play in community energy
2/19	Green alliance community energy 2.0 report	Save noted within report alongside SCMZ's
3/19	We Got The Power'	UoS working paper based on SAVE reporting of statistical analysis circulated
3/19	Network Awards	'Stakeholder Engagement initiative of the Year' Winner
3/19	SAVE presented at Networks Conference	SAVE project presented as transition to SCMZ project
4/19	SAVE Ofgem Lunch and Learn	Presentation with DSO technical Authority and Head of Network Trading- 25 min presentation on SAVE with 20 mins for Q and A. SAVE received well with interest in data availability
4/18	ICREN 2019 conference, Paris	Presentation of two papers (one with DNV-GL) at International Conference on Renewable Energy ICREN 2019 conference, UNESCO, Paris
5/19	SAVE Supplier Workshop	See Appendix 2.4b
6/19	Parliamentary Closedown event	As per closedown report and appendix 10.5-10.7
7/19	Energy Live News article	Dissemination of SAVE report on 'essential capacity' https://www.energylivenews.com/2019/07/02/efficiency-measures-could-help-cut-uk-domestic-consumption-by-2-5-million-mwh/
7/19	Utility Week News Article	Dissemination of SAVE report on 'essential capacity' https://utilityweek.co.uk/citizens-advice-and-ssen-investigate-core-capacity-of-network-users/
7/19	Electric Energy Online	SAVE press release publication of closedown reports and final learning. https://electricenergyonline.com/article/energy/category/Energy-Efficiency/82/777769/SSEN-s-SAVE-project-findings-show-significant-reduction-in-carbon-emissions-and-household-energy-costs-.html
7/19	ENA NIT Dissemination	Discussion with ENA to understand WSP tool and provide overview of NIT to ensure shared learning and understanding of purpose of each model.
7/19	ENA Working group disseminations	Presentation on the NIT to provide an overview to all DNO's and to set up roadshows

8/19	UKPN DNO Roadshow	Half-day tailored dissemination to discuss key SAVE learning and provide training on SAVE’s NIT as well as how this could fit with UKPN’s organisation structure. Supported by twitter campaign.
9/19	teleconference with Policy Advisors, Ministry of Business, Innovation and Employment, NZ	Discussion displaying evidence of effectiveness of price and other incentives for customer demand response in the UK.
9/19	NPG DNO Roadshow	Half-day tailored dissemination to discuss key SAVE learning and provide training on SAVE’s NIT as well as how this could fit with NPG’s organisation structure. Supported by twitter campaign.
9/19	SHEPD DNO Roadshow	Half-day tailored dissemination to discuss key SAVE learning and provide training on SAVE’s NIT as well as how this could fit with SHEPD’s organisation structure. Supported by twitter campaign.

Appendix 9.1- Twitter Statistics

28/06/2019

SSEN Innovation @SSEN_FN
SSEN published today, Core Capacity, investigating fairer ways of charging energy customers, with the uptake of smart meters, electric vehicles and electric heating. https://bit.ly/2X9icIU This comes with a sister report published by **@citizens #ssensaveproject @CAenergypolicy**

Reach a bigger audience
Get more engagements by promoting this Tweet!

Impressions	776
Total engagements	39
Link clicks	15
Likes	10
Profile clicks	9
Detail expands	3
Retweets	2

13/06/2019

SAVI
ieving Value fron

SSEN Innovation @SSEN_FN
A big thank you to all those that attended our **#SAVEClosedown** events which took place last week. Great panel discussions and audience participation, read more here: http://news.ssen.co.uk/news/all-articles/2019/june/ssen-reveals-findings-of-five-year-save-project-at-westminster-closedown-events/ ... pic.twitter.com/VoleAk2Iq5

Impressions	513
Total engagements	8
Link clicks	3
Likes	2
Detail expands	2
Retweets	1

06/06/2019

SSEN Innovation @SSEN_FN
Who's ready for part 2 of our **#SAVEClosedown** event? We are now at Portcullis House, Westminster. Delighted to have a good mix of delegates attending. **@ssencommunity** pic.twitter.com/LWMPWZ4u6d

Reach a bigger audience

Impressions	1,021
Total engagements	25
Hashtag clicks	9
Media engagements	5
Likes	4
Profile clicks	4
Detail expands	3

06/06/2019

SSEN Innovation @SSEN_FN
Jenny from the Shirley Warren community, is currently presenting about how the SAVE project has transformed their community. They are even in the process of organising their second 'big switch off' event. **@ssen_fn #Saveclosedown** pic.twitter.com/K7csO8lDuf

Impressions	777
Total engagements	9
Media engagements	6
Likes	1
Hashtag clicks	1
Detail expands	1

06/06/2019

SSEN Innovation @SSEN_FN
Our SAVE website is now available. Hear all about our high profile project and see all presentations from today's event. https://save-project.co.uk/ **#Saveclosedown** pic.twitter.com/9tBomTFELT

Reach a bigger audience
Get more engagements by promoting this Tweet!

Impressions	919
Total engagements	22
Link clicks	9
Likes	5
Profile clicks	3
Retweets	2
Media engagements	2
Detail expands	1

06/06/2019

SSEN Innovation @SSEN_FN
Scottish and Southern Electricity Networks are at Central Hall Westminster for our Project SAVE closedown event. Presentations underway thanks to our industry experts. **#LEDBulbs** **#SAVEclosedown** pic.twitter.com/s1g0ILHNDE

Reach a bigger audience

Impressions	2,550
Total engagements	44
Media engagements	26
Likes	5
Detail expands	5
Retweets	4
Hashtag clicks	3
Link clicks	1

05/06/2019

SSEN Innovation @SSEN_FN
Who's ready for our **#SAVEClosedown** event tomorrow? We are all set in **@CentralHall** London! pic.twitter.com/WrSHgUqLoN

Reach a bigger audience
Get more engagements by promoting this Tweet!

Get started

Impressions	690
Total engagements	26
Detail expands	9
Media engagements	8
Likes	4
Hashtag clicks	2
Profile clicks	2
Retweets	1

27/05/2019

SSEN Innovation @SSEN_FN
Our SAVE closedown event is next week - 6 June 2019. There is still time to book. Click here for the event at Central Hall: https://bit.ly/2L2a24s and here for Houses of Parliament: https://bit.ly/2ZxkpRb . Take a look at our packed agenda's. **@ssencommunity** **#SAVEClosedown** pic.twitter.com/x2TvgLsPAc

Impressions	3,038
Total engagements	53
Media engagements	33
Likes	7
Detail expands	5
Link clicks	4
Retweets	3
Profile clicks	1

23/05/2019

SSEN Innovation @SSEN_FN
We are in the capital today finalising the arrangements for our **#SAVEClosedown** event on the 6th June. Have you registered yet? You can register for one or both parts Central Hall: https://bit.ly/2L2a24s Houses of Parliament: https://bit.ly/2ZxkpRb **@ssencommunity** pic.twitter.com/RI2tn19Jkw

Impressions	2,310
Total engagements	19
Media engagements	7
Likes	6
Retweets	4
Hashtag clicks	1
Detail expands	1

22/05/2019

SSEN Innovation @SSEN_FN
'Putting stakeholder engagement at the heart of our business' delighted to have SSEN's Charlie Edwards presenting at this session **@UtilityWeekLive** as winner of **@network_mag** best stakeholder engagement initiative **@ssencommunity** # pic.twitter.com/QmjucvchjK

Impressions	2,339
Total engagements	37
Media engagements	19
Likes	9
Detail expands	5
Retweets	2
Link clicks	2

10/05/2019

SSEN Innovation @SSEN_FN
Our SAVE project is coming to a close. To hear more about the project and to register, just click this link. **#SSENSAVE #SAVEClosedown** http://news.ssen.co.uk/news/all-articles/2019/may/ssen-to-hold-closedown-events-for-multimillion-pound-energy-efficiency-project-in-westminster-on-6-june/ … pic.twitter.com/oq54pRGwRn

Impressions	1,276
Total engagements	7
Likes	2
Retweets	1
Media engagements	1
Link clicks	1
Hashtag clicks	1
Profile clicks	1

08/05/2019

SSEN Innovation @SSEN_FN
Our SAVE project is kicking off its project closedown at Colin Street, Neighbourhood Centre in London, with a dissemination workshop to electricity suppliers. #SSENSAVE #SAVEClosedown @ssencommunity pic.twitter.com/MkmWnXQoRW

Reach a bigger audience
Get more engagements by promoting this Tweet!

Impressions	2,341
Total engagements	40
Media engagements	26
Likes	6
Retweets	3
Detail expands	2
Profile clicks	2
Hashtag clicks	1

07/05/2019

SSEN Innovation @SSEN_FN
Randolph Brazier, Head of Innovation and Development @energynetworks is also joining our panel of experts, at part two of our SAVE closedown event in London. Have you registered yet? Part one: https://bit.ly/2L2a24s Part two: https://bit.ly/2ZxkpRb #SAVEClosedown @ssencommunity pic.twitter.com/2jJRGeg6fj

Impressions	2,020
Total engagements	23
Link clicks	6
Retweets	5
Detail expands	5
Likes	3
Profile clicks	3
Media engagements	1

26/04/2019

SSEN Innovation @SSEN_FN
Our award winning SAVE project is coming to an end. Why not join us at our two part closedown event on the 6th June in London. To SAVE the date, click here for part one: https://bit.ly/2L2a24s and here for part two: https://bit.ly/2ZxkpRb #SAVEClosedown @ssencommunity pic.twitter.com/EZZH7d943h

Impressions	1,803
Total engagements	21
Media engagements	8
Likes	5
Link clicks	5
Retweets	3

26/03/2019

SSEN Innovation @SSEN_FN
Amazing work from all those involved in our #SSENSAVEProject. Delighted to have won Stakeholder Engagement Initiative of the year! @ssencommunity pic.twitter.com/EQDoh0RKNu

Reach a bigger audience
Get more engagements by promoting this Tweet!

Impressions	3,193
Total engagements	24
Media engagements	8
Likes	8
Detail expands	5
Retweets	1
Hashtag clicks	1
Profile clicks	1

06/03/2019

SSEN Innovation @SSEN_FN
Great event last night at the **#UKCSAwards**, although no wins this time, we were excited to have been nominated as a finalist for our SAVE project in the 'Best return on customer service investment' category. **#SSENSAVE #Finalist #SolentAchievingValuefromEfficiency** pic.twitter.com/ejflx2jypc

Reach a bigger audience
Get more engagements by promoting this Tweet!

Impressions	736
Total engagements	38
Media engagements	14
Likes	8
Detail expands	7
Link clicks	4
Hashtag clicks	2
Profile clicks	2
Retweets	1

05/12/2018

SSEN Innovation @SSEN_FN
No wins tonight but delighted that our ANM, Power Track and SAVE projects were all finalists at this year's **@EnergyAwards** . Well done to all those that won and reached the finals. **@ssencommunity @SSEN_FN** pic.twitter.com/nlz01DhJlc

Reach a bigger audience
Get more engagements by promoting this Tweet!

Impressions	6,826
Total engagements	218
Media engagements	165
Likes	21
Profile clicks	16
Retweets	6
Detail expands	6
Link clicks	3
Replies	1

21/11/2017

SSEN Innovation @SSEN_FN
Presenting on how our innovation project, SAVE, is providing evidence into the value of energy efficiency in running networks, supporting customers and supporting government obligations. pic.twitter.com/bkgWj6yJRK

Reach a bigger audience
Get more engagements by promoting this Tweet!

Impressions	716
Total engagements	40
Media engagements	29
Replies	4
Profile clicks	3
Retweets	1
Likes	1
Link clicks	1
Detail expands	1

Appendix 9.2 Open Days

The below Appendix first shows a full summary of Open Day 6, part of the CEC trials. This is followed by an overview of Open Day’s 7 and 8 held with data informed and price signal trial groups showing the event invite and material presented on the day of the event.

INVITATION

SAVE Community Energy Coaching Trial

Final Dissemination Session

Thursday 15th March 2018

10am (for a 10.30 start) – 1.30pm (including lunch)

@the Shirley Warren Action Centre, Warren Crescent, Southampton. SO16 6AY

You are cordially invited to join with key Stakeholders and residents from Kings Worthy and Shirley Warren to an independently facilitated review of the SAVE coaching trial and the lessons learned

Your input is vital to us in ensuring that our final report to Ofgem reflects your views of the journey we have shared

We will be showing an updated version of the 'Making Emotional Connections' video and will have some positive data to share!

A slow cooked lunch will be provided so please let us know if you have any special dietary requirements

If you are arriving by car let us know (please consider car sharing)

We would dearly love for you to attend this last formal landmark on our SAVE journey together - help us celebrate the successes we've shared and capture the learning for the future

Please RSVP by Thursday 8 March to judi@neighbourhood-economics.com
or call Judi on 07985 294528

Best Wishes
Judi and John
Neighbourhood Economics

SAVE Coaching Trial - Final Dissemination Workshop Session – 15 March 2018

FEEDBACK REPORT

1 The Purpose of the Workshop

The purpose of the workshop was to get feedback and share lessons learned on the SAVE project from residents and other stakeholders (utilities, local authorities etc) who have helped support and review the project. It was led by an independent facilitator, James Martin-Jones.

SAVE

Solent Achieving Value from Efficiency

SAVE Coaching Trial - Final Dissemination
Workshop Session – 15th March 2018

Purpose: To get feedback and share lessons learned on the SAVE project – both from the residents, and also from the other stakeholders (utilities, local authorities etc) who helped support and review the project.

10.30: START

Session 1: See the video and have a quick chat about it

Session 2: Get your feedback on the two key stages of the project in turn:

- The initial engagement with the communities
- The main stage of the engagement – energy issues etc

12.00: Lunch

12.30: Final session

- What's changed?
- Final reflections/ observations
- Lessons learned
- One or two key takeaways
- Way forward/next steps

End by 13.30

The format was to invite participants to sit at tables of 5/6 mixing everyone up so that each table included, as far as possible, residents of Shirley Warren, Kings Worthy and other stakeholders. Each table agreed 2/3 thoughts on each stage of the project in turn. These were noted on table sheets and followed by feedback and discussion in plenary as recorded on flip charts. Both table and flipchart notes are included in this report, along with a summary interpretation of the key points emerging for each stage.

The event began with a showing of the updated 'Making Emotional Connections' (Part 2) video.

2 Session 1: See the video and have a quick chat about it

Key Points:

- The Community Coaching approach was endorsed as having provided a very positive shared experience for all involved – residents in particular benefitting from the bottom up, 'joint' nature of the project.
- The video format is seen as very useful engagement tool with suggestions for an 'external' version to promote the project – in particular using local people to demonstrate the power of the community voice and experience.
- The success of tailoring the approach to meet the needs of both communities was seen as key and raises issues of how it can be scaled up to reach more people.

Flipchart notes:

- The project was grassroots led, bringing together different people within the community.
- It was a two-way thing – it was a good experience because of that
- It was an equal partnership – a joint project (not "being done to")
- It was about more than just energy – it was about wider community benefit
- The project listened to the communities' own agendas first
- We should make a different video to show others as a good tool to introduce the project. This "public" version should include more community voices, showing the impact and the power of ordinary residents
- There should be a comparison across the two trial areas, showing how the different communities responded, and the type of activities
- How do you scale up this approach to talk to more "customers"?
- The approach was the same in each community, but the outcome was different in each – this also needs to be shown in the external version of the video
- The success of the project needs to be highlighted and fed back in the communities to encourage more people to get involved

Table notes:

- The content of the video was covered too quickly – slow down! SAVE was accepted as a "trusted messenger" – this was a key element – meeting people where they are. The importance of demonstrating the positive impact of the approach. Highlighting the value of apparently unrelated activities (new people connected)
- The video was a fair representation of both communities. Very encouraging to see solutions. Good to see progress across both areas. Could be expanded to more people. The statistics could be used to encourage others. So much happened over the last 3 years
- We have achieved what we set out to do – the video demonstrates this.
- Fantastic for Shirley Warren: lots got on board – some not known before. Created community spirit. Good experience – two-way thing. Changed people's habits: switching off standby; lights off; phone overnight; awareness of 4pm-8pm

3.1 Session 2: Get feedback on each of the two key stages of the project

<u>Stage 1</u> – the initial engagement with the communities – that is, when SAVE got in touch and started by asking the two communities about their issues.

<u>Key Points:</u>

- The fact that energy was not the initial focus but rather, getting to know and support each community's own aspirations, was critical to getting people on board, developing the trust relationships and to the success of the project.
- The energy message turned out to be far more interesting and relevant then people thought it would be
- The approach of being part of the community rather than the more traditional 'top down' external approach meant that the natural suspicion that people have for the big energy companies was dissipated to a large extent, although for some it remained an issue

Flipchart notes:

- In Shirley Warren, it was about bringing people together. In Kings Worthy, it was more about bringing organisations together
- Energy saving was not the headline – it was about the needs of the communities
- It was about looking for a common purpose – in Kings Worthy the focus that emerged was around walking; in Shirley Warren, it was around food
- The project offered "something for nothing", backed up with actions in an equal collaboration
- Mobilising the community is key
- In Shirley Warren, energy turned out to be interesting (more than expected)
- In Shirley Warren the project tapped into existing networks
- The project approach allowed "hearts and minds" engagement
- With "stakeholder organisations" you need to take the time needed to achieve results
- Some residents asked why they should support the project, given that SSEN is a private company – this was (and remained) an obstacle for quite a few residents
- The key message was adapted to "Reduce at peak"

Table notes:

- Energy saving was not mentioned at first contact – this was the right approach – i.e. what can we do for you? This meant that our minds were open. The focus was on getting the community to where it needed to be. Being part of the community. In Shirley Warren, the project "created a community"; helped people meet each other; gave people an opportunity to engage within the community. Helped create community café. In Shirley Warren it was about bringing people together
- Incentives (vouchers) to attend meetings helped, as did food – cheese and wine
- Social media also helped (via Alison). Kings Worthy: Local councillor excited by the idea of a common plan; how to get through the village on foot – how to encourage a healthy, active, connected green community
- This was a different approach to engaging with the community. It built on the existing links between community and church

3.2 Session 2: Get feedback on each of the two key stages of the project

Stage 2: The main stage of the engagement – that is, when SAVE explained the energy issues and asked the communities to help them explore how they might be able to help address them.

Key Points:

- The messages needed to be simple, relatable and visual where possible – once these had been refined together through the co-design process the community became active champions to share the messages
- Seeing the community as part of the solution and not just the problem was key to resident engagement and empowerment – people enjoyed sharing the role of problem solver and advocate through the co-design and focus groups and other regular interaction.
- The trust relationships that have been developed have been crucial to the development of local people as 'human messengers' who can deliver with much more power than a mail shot

Flipchart notes:

- The Big Switch Off – the end of the "snowball effect" – helped get the word out: accumulation of energy knowledge, so that the communities became "sharers" of the knowledge, widening the net/impact
- Energy awareness and understanding were raised, so that the community could become problem solvers and advocates
- Human messengers better than mail shots
- "Power draw" graph a very powerful tool in promoting understanding, in a visual, meaningful way
- Freebies/prizes (shower timers, LED lights, slow cookers) – kept interest up and human touch allowed conversations to take place across the community
- The simpler the message the better
- Understanding of the energy infrastructure – the alternatives e.g. between upgrades or reduced use of power – members of the community becoming problem solvers
- Recognising the realities – e.g. that parents with children need to cook between 4pm and 8pm – but slow cookers and different ways of cooking were taken on board
- Scaleability: need to invest in social infrastructure
- Definitely affected the way we use energy – using less/at different times – taking to other – spreading the message – being "champions"
- Energy efficiency now on the agenda/a topic of conversation
- In Kings Worthy the two churches have encompassed the message for the first time
- Shirley Warren WT now constituted – has created a community hub – safe, joined up, and inclusive
- Catalyst for change/creating community energy
- Created an opportunity to have other important conversations.

Table notes:

- Agreeing where and when savings can be made – waiting till 8pm not appropriate for all. Provide alternatives ideas and solutions. Slogans do help. Providing information to help people make

wise decisions. When it works, people spread the word. Human messages are better than mailshots
- Hearing about the substations – that if they have to be replaced, the costs will have to rocket. Absolutely changed habits. Little gizmos helped – e.g. to use with showers. The cooking side was more difficult to use. A section of the community wanted an upgrade to the infrastructure. Should work more with children and families – start it earlier. It gave an opportunity to discuss this in the community – human messages are better than mailshots
- No hard sell has always been one of the objectives. It was all interlinked. Holding events to encourage awareness of the 4pm-8pm period. Showed people the ideas. People want to know the easy route – not to have to spend time working it out – slight adjustments to lifestyle

4.1 Final session

<u>Part 1</u>: Looking at the project as a whole, what if anything has changed for you or the community in the short or long term?

<u>Key Points:</u>

- Both communities have expressed a real sense of the greater ‘connectedness’ that exists as a result of the project – both between individuals and groups with the community and with the support available to them externally.
- Real, positive, sustainable impacts have been achieved to support the social fabric in each e.g. the community café and clean ups in Shirley Warren and the reinstatement of the walking bus and Eco Church development in Kings Worthy
- As part of the SAVE legacy there is a much greater awareness of energy issues, including the role of the DNO and peak demand, alongside an appreciation of wider environmental issues with real willingness to keep them on the local agenda for action.

Flipchart notes:

- SAVE has given the wider community access to “joining up” – through the café, babysitting, etc.
- There was always community spirit here in Shirley Warren, but it needed help to bring it out. Starting where the community is at is vital
- Lifelong friendships have been established as a result
- Improved networks and connections
- SAVE has been a focal point for other organisations to reach into the community
- There is raised awareness of the help that is available
- In Kings Worthy, the walking bus has been reinstated; and 200+ children play in the park every morning before school
- It has made the community more active – it’s been a booster
- How do we reinforce the energy message?
- The Big Switch Off has been very successful in Shirley Warren – we intend to repeat it every year. Thinking about the possibility of tying it in with Earth Hour

Table notes:

- Kings Worthy: the local church has gone for EcoChurch rating, and the next door church is moving in that direction. There is more of a sense of community and connection. There is a place to go to make connections. Working hard to move away from just the church to a HUB. Sustainability for community gatherings. A more open community. The SAVE project facilitated the community to come together. Very much supported
- Community noticeboard – investing in the fabric of society. The project has affected the way we use our energy – e.g. when/if we use the tumble drier; using a slow cooker. It has provided an opportunity to talk to people in the community – common ground; signposting – meeting people and getting confident to go to get help
- Greater community involvement. Improved networking/connections. More aware of “peak power” issue and ways to address it/save energy. Made people think differently about energy/environment. Energy awareness events very successful – need to keep them happening. Change in habits. The desire to reach out to the wider community and increase school involvement

4.2 Final session

Part 2: Any final reflections, observations, conclusions, key lessons learned from your experience of the SAVE project…one or two key things you will take away from the project with you - keep doing or do differently from now on?

Key Points:

- The Community Coaching approach has proved successful in adapting its delivery to suit each community and building trusted relationships to deliver the energy agenda
- Having energy as thread that was interwoven in local conversations, rather than as a standalone subject, has been a key factor in the project's success and paves the ways for more integrated approaches with the 3 utilities and other partner organisations.
- Opportunities for local ongoing promotion of the energy 'story' has been identified through Jackie's regular monthly columns and Jenny's sermons as well as through Earth Hour and other proposed follow up BSO events.
- The challenge of educating children and young people (particularly those becoming independent) is seen as critical in achieving long term behaviour change and developing new social norms.

Flipchart notes:

- Kings Worthy – Jackie Porter has a monthly column in 8 publications – she is going to include a slot on energy in each one from now on (if Jenny will include something on it in her sermons!)
- Hoping to install solar panels on community buildings; and to start a blog on best energy efficiency practice – e.g action on lights, loos that only flush when used, etc.
- The softly softly approach is crucial to gaining trust
- Children's involvement is important – most challenging age when newly independent.
- Using a local approach adapted to suit each situation/community
- On-line app needed to spread key messages to wider audiences
- Energy was seen as a thread running through conversations – not as a stand-alone
- Support the idea of a combined utilities approach to enable a joined up conversation about scaling up energy efficiency. This is beginning to be thought about at higher levels
- Make The Big Switch Off an annual event to keep energy at the front of people's minds

Table notes:

- Collaborate on the SAVE approach with water, gas, and energy companies and with OFGEM and OFWAT (and telecoms?) – to get more awareness of consumption – similar to The Big Switch Off to promote best practice – e.g. switch all appliances off when not in use; batch cooking in slow cooker. Reminder events. In conclusion, SAVE has been more successful than just saving energy and money. Connections established with companies.
- Develop an app to share connected messages. Move away from silo communications. There is a lot of commitment in the community to continue this good work. Shirley Warren has set up a committee to take it forward.
- Carry on as we have been doing. Jackie Porter's columns to include energy. Kings Worthy planning an energy audit and possibly installing PV panels- haven't been able to get funding for this or other improvements in the village hall yet. Would also like to have a blog on best practice.
- Need a softly softly approach – gain trust. Need to make children more aware, and educate parents – partnering with the school(s) perhaps. Young adults are harder to reach. Adapting to the local area is vital.

5 Way forward/Next Steps

It was agreed that Judi and John would circulate the draft report of the workshop to all participants by 22 March and that participants would then send any corrections/ additions/edits to the report back to Judi and John by 30 March. Judi and John would then circulate the final version of the report to all by 6 April.

This report, when finalised, will form part of the final SAVE project report that Judi and John will submit, with SSEN approval, to Ofgem in June 2018.

JMJ/NEL/April 2018

OPEN DAYS 7 AND 8

UNIVERSITY OF Southampton

4 TO 8

SAVE

Solent Achieving Value from Efficiency

Thank you for confirming your attendance at our second project open day.

This event will offer you and other participants in the SAVE project the opportunity to discuss the trials we've conducted so far and our future plans.

***When:* 6-8pm, Tuesday 17th April**
***Where:* University of Southampton Campus,**
Hartley Suite (Building 38, Conference & Hospitality)

Parking will be available on site. It is recommended that visitors use the pay and display parking (free after 5pm) marked on the attached map.

Alternately there are numerous Unilink buses that stop at 'Highfield Campus Interchange', see *www.unilinkbus.co.uk/page.shtml?pageid=942* for more details.

What's on the agenda?

An introduction from Scottish & Southern Electricity Networks
Please arrive at 5.45 for a 6pm start
Canapés, tea and coffee will be served throughout your arrival

Decoding energy data
The latest insights and trends in how participating households like yours are using electricity, from the University of Southampton

Break – an opportunity to meet the team and ask us questions
Tea and coffee

SAVE – looking back at the latest trials
Your opportunity to feedback on the most recent part of the project and have another look at the materials that we've been sharing

What's next?
We want to hear your thoughts on our plans for the next phase of the trial which will take place this winter

The event will finish by 8pm at the latest
With a £30 voucher as a thanks for coming along

Should you have any queries on the day please contact: Charlie Edwards on xxxx xxx xxxx

SAVE

Solent Achieving Value from Efficiency

Scottish & Southern Electricity Networks

Meet the team

Elizabeth Steele, Trial Design

Rob Moore, Trial Design

Tom Rushby, Researcher

Charlie Edwards, Project Manager

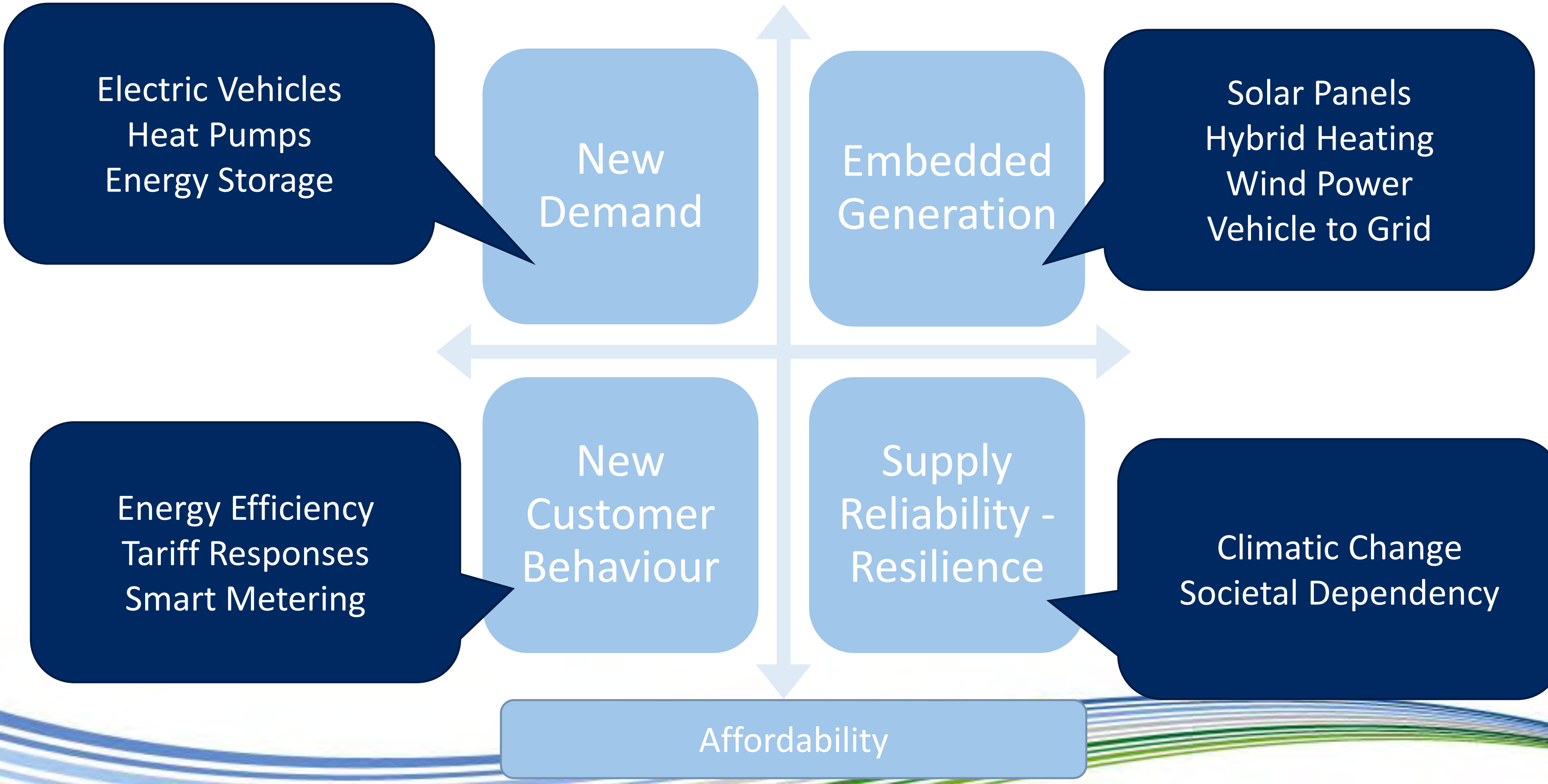
Scottish & Southern Electricity Networks

Challenges for Electricity Distribution Networks

Scottish & Southern Electricity Networks

Why 4to8

Challenges for Electricity Distribution Networks



Distribution project portfolio

Reliability & Availability

Connections & Capacity

NINES	Thames Valley Vision	My Electric Avenue	SAVE – Solent Achieving Value from Efficiency	LEAN
Shetland 1MW Battery	LV Network Monitoring	Impact of Electrolysers on the Network	ACCESS (Community Energy)	Orkney Energy Storage Park
LV Connected Energy Storage	Digital Substation Platform	Domestic Demand Side Management	Network Damage Reporter	Field Team Support Tool

Customer & Social Obligations

Safety, Health & Environment

Scottish & Southern Electricity Networks

SAVE

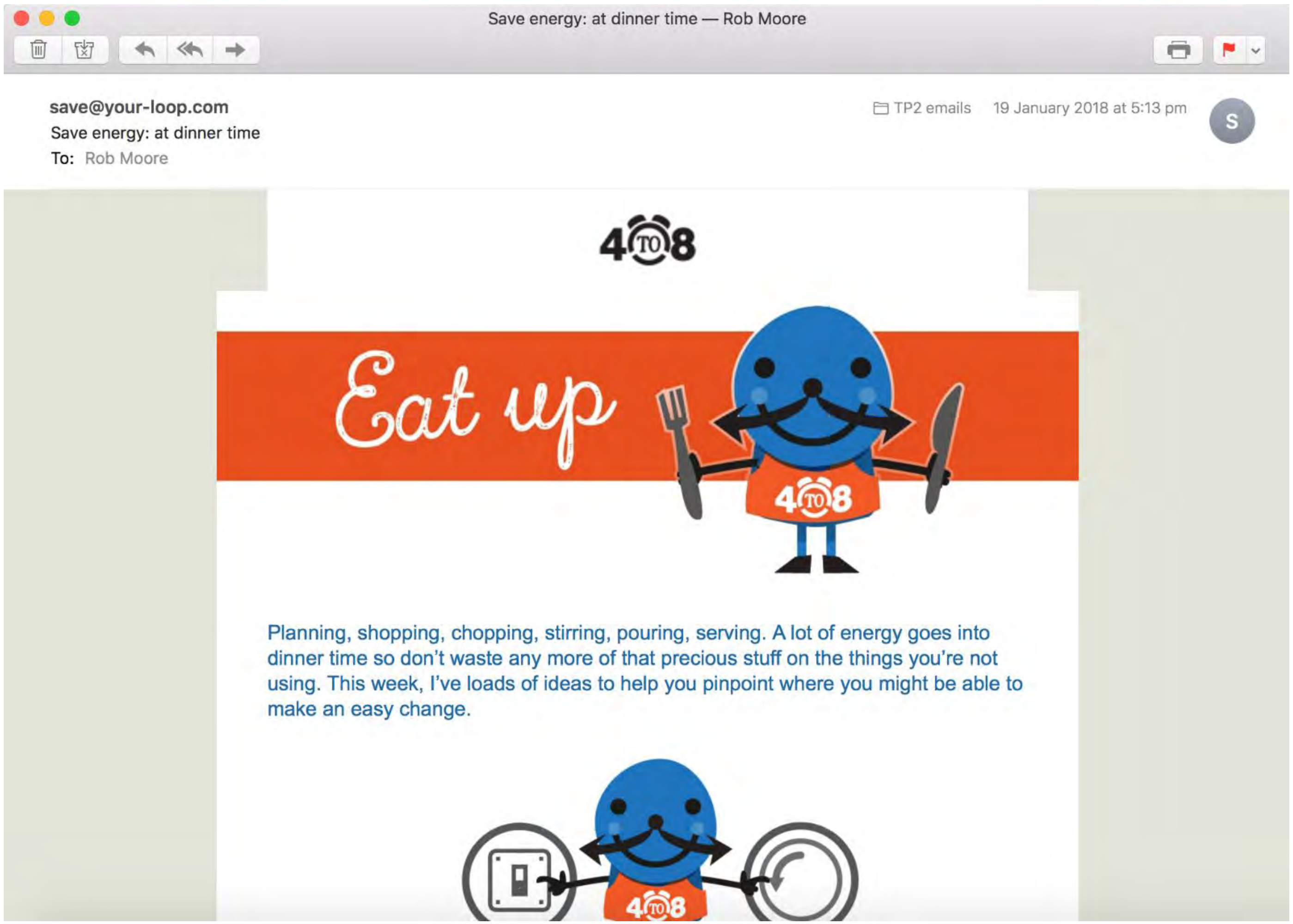
Solent Achieving Value from Efficiency

Scottish & Southern Electricity Networks

Break

Looking back at the latest trials


4 TO 8

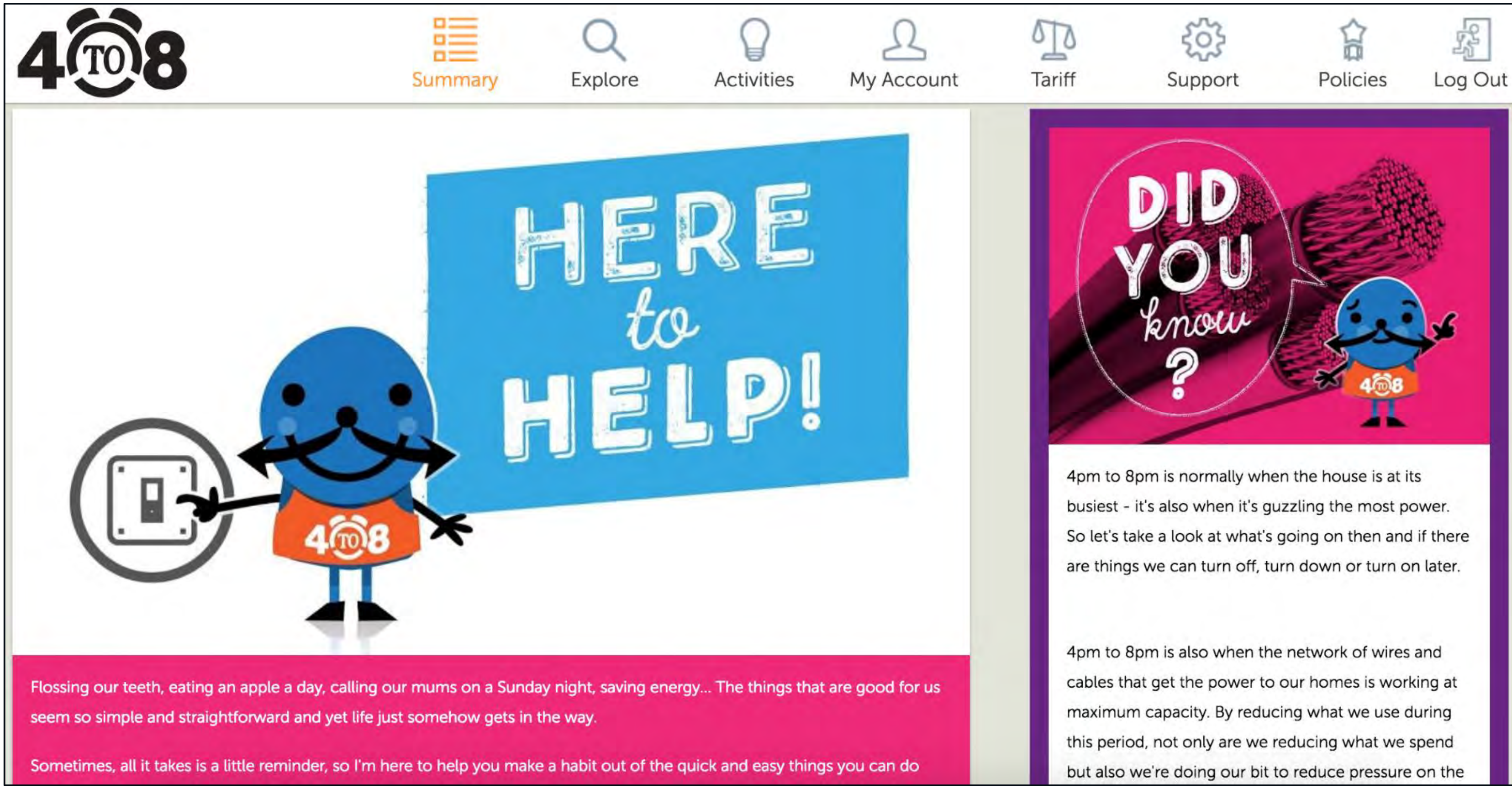


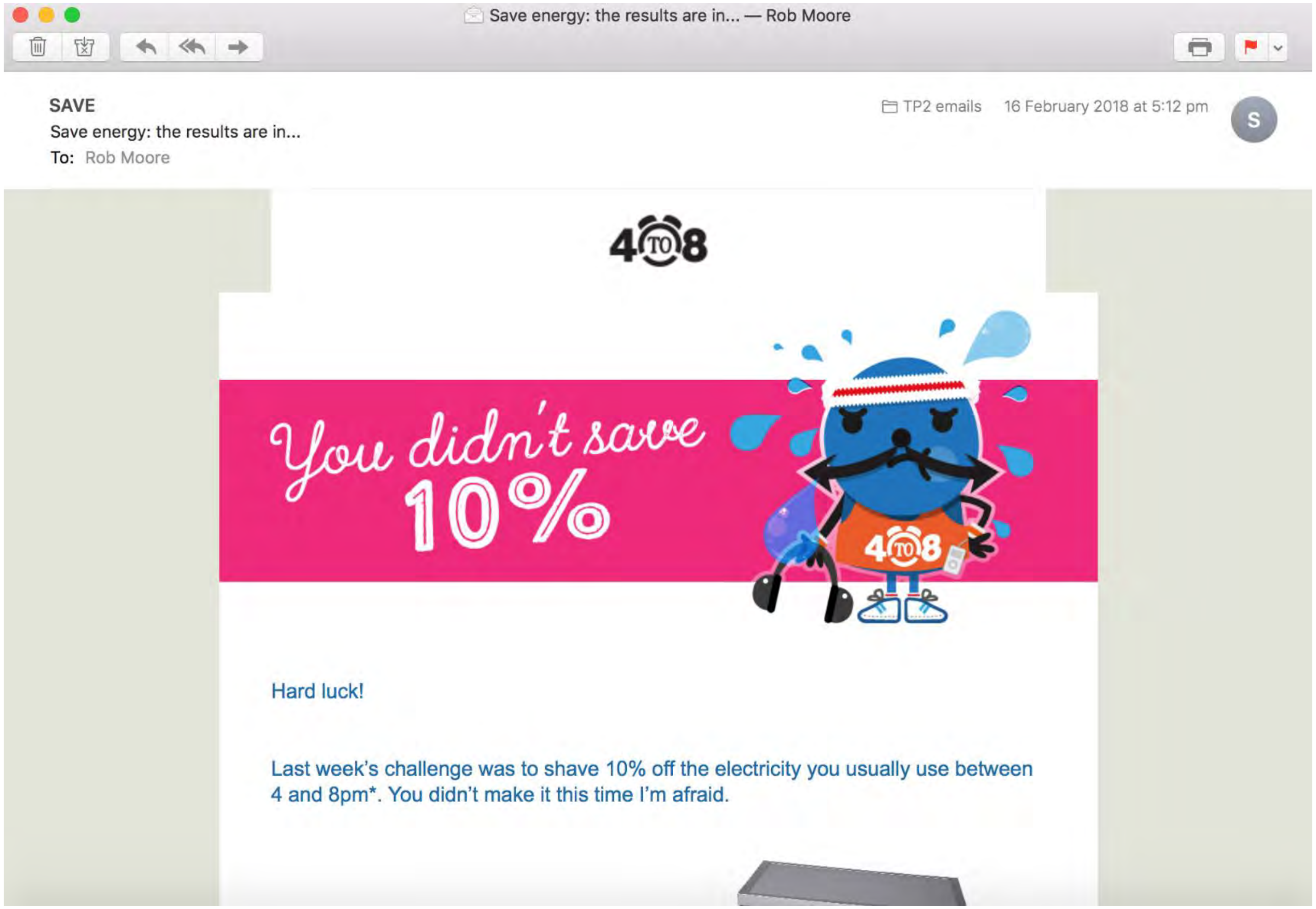
Save energy: at dinner time — Rob Moore

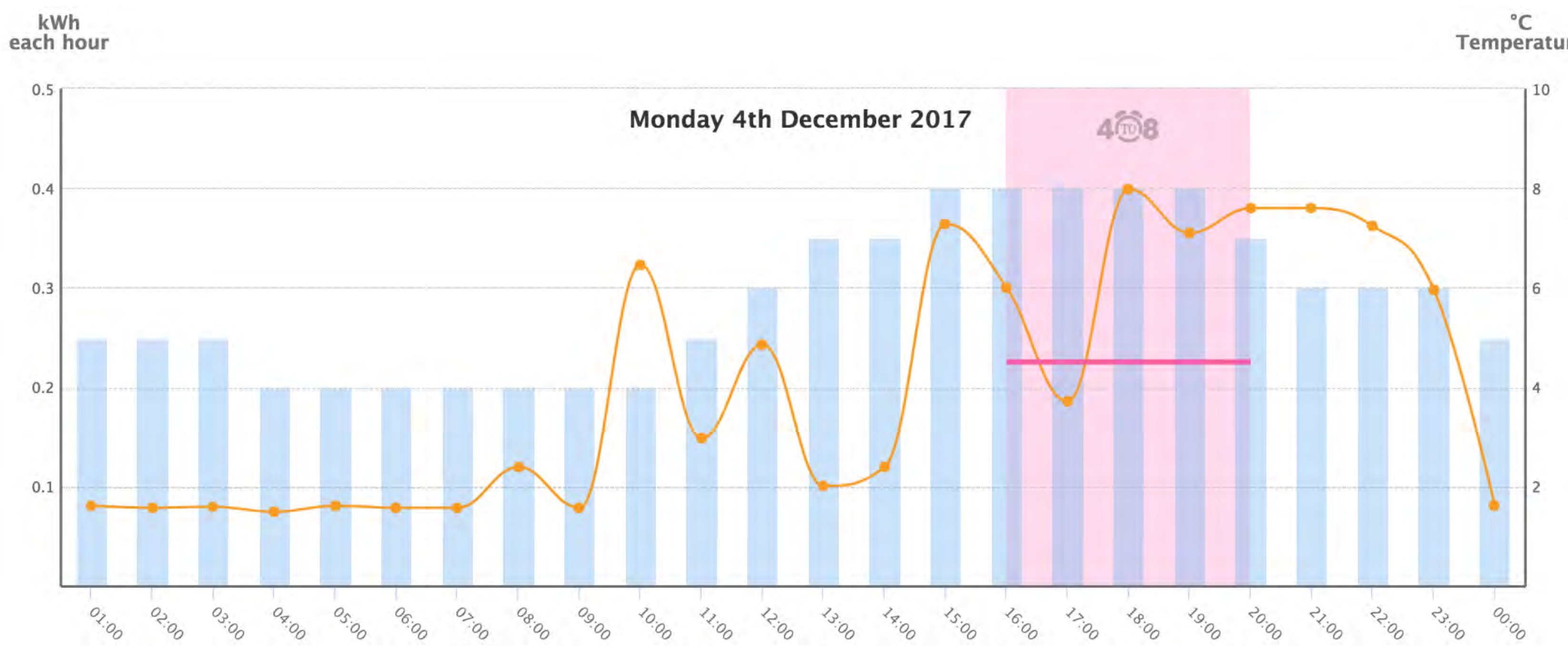
save@your-loop.com
Save energy: at dinner time
To: Rob Moore

TP2 emails 19 January 2018 at 5:13 pm

Planning, shopping, chopping, stirring, pouring, serving. A lot of energy goes into dinner time so don't waste any more of that precious stuff on the things you're not using. This week, I've loads of ideas to help you pinpoint where you might be able to make an easy change.


4 TO 8
Summary
Explore
Activities
My Account
Tariff
Support
Policies
Log Out
HERE to HELP!
4 TO 8
DID YOU know ?
4 TO 8
4pm to 8pm is normally when the house is at its busiest - it's also when it's guzzling the most power. So let's take a look at what's going on then and if there are things we can turn off, turn down or turn on later.
4pm to 8pm is also when the network of wires and cables that get the power to our homes is working at maximum capacity. By reducing what we use during this period, not only are we reducing what we spend but also we're doing our bit to reduce pressure on the
Flossing our teeth, eating an apple a day, calling our mums on a Sunday night, saving energy... The things that are good for us seem so simple and straightforward and yet life just somehow gets in the way.
Sometimes, all it takes is a little reminder, so I'm here to help you make a habit out of the quick and easy things you can do


Save energy: the results are in... — Rob Moore
SAVE
Save energy: the results are in...
To: Rob Moore
TP2 emails
16 February 2018 at 5:12 pm
S
4 TO 8
You didn't save
10%
4 TO 8
Hard luck!
Last week's challenge was to shave 10% off the electricity you usually use between 4 and 8pm*. You didn't make it this time I'm afraid.


kWh
each hour
°C
Temperatur
Monday 4th December 2017
4 TO 8
0.5
0.4
0.3
0.2
0.1
10
8
6
4
2
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
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10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00

3 10:52 am 93%

RealTime Spend Budgets

So I've already talked about how we generally use the most electricity from 4to8pm. But what I haven't told you is that of all of the days of the week, Sunday is when we actually use the most.

So this Sunday, why not have a look at what's on around your house from 4to8. Does everything need to be on? Maybe a little whip round the

What’s next?

This Autumn, take advantage of our new incentive plan

We're going to monitor your usage as usual between 4 and 8pm, over the next 3 months.

So long as you keep your electricity usage below a target level we'll pay you a rebate of 5p per unit.

You could do this by cutting your use of high-energy appliances during those hours or shifting it outside of them.

We'll tot it up and pay you a lump sum at the end of the 3 month period (up to a maximum value TBC).

Track your progress and see how your rebate is adding up via your Loop account. We'll also send you a weekly text to let you know your balance.

Thank you!

Appendix 9.3- SAVE Closedown Customer Survey

At the close of SAVE's final trials, price signal, customers (TP3 and TP4) were asked to complete a closedown questionnaire about electricity usage, actions taken to reduce it during peak periods, and change of habits. The methodology for this was built from Low Carbon London's (LCL's): "Residential consumer attitudes to time-varying pricing report" readjusted to provide SAVE relevance. This allows for, in some cases, a direct comparison between SAVE and LCL trial results. Three hundred participants took part in the questionnaire.

Questionnaire Result

Customers efforts

Figure 1 explores the question: *Thinking about your efforts to use less electricity during the peak period (4 to 8), which were you able to use flexibly?* With a choice of multiple different types of in-home activities. As would be hypothesised from literature in SDRC 1, laundry and cleaning were noted most flexible with 24% of customers claiming to be able to apply flexibility "always", and 29% answering "frequently". 39% of customers use kitchen appliances "occasionally" between 4pm and 8pm. On the other hand, home entertainment, heating, and bathroom appliances result to be the most difficult to shift.

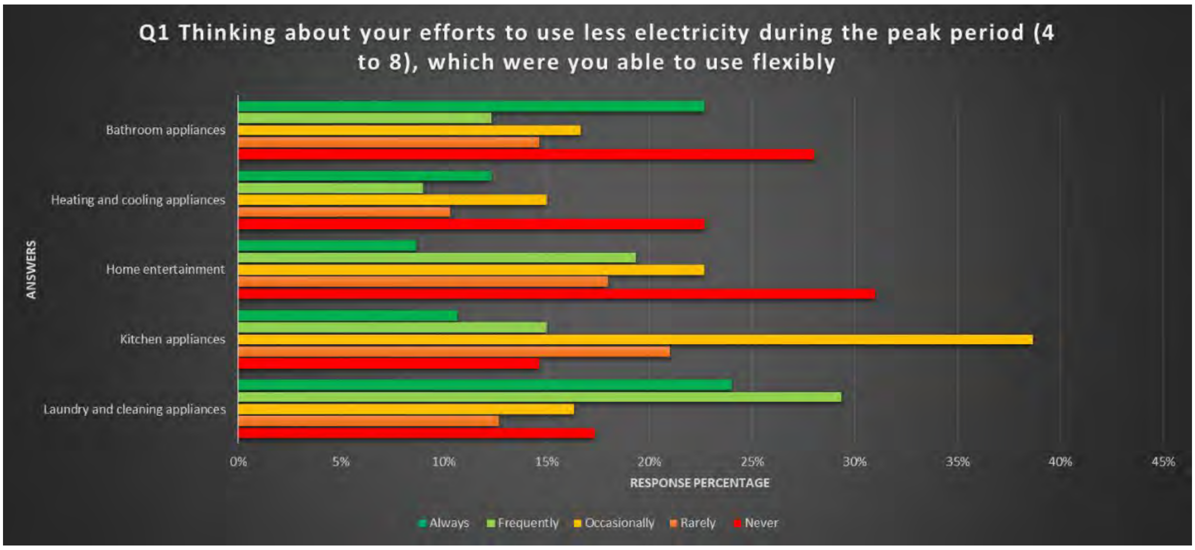


Figure 1 Q1: Thinking about your efforts to use less electricity during the peak period, which were you able to use flexibly?

In question 2 customers were asked in which day of the week they best managed to shift habits to perform the activities shown in figure 1 outside the peak period.

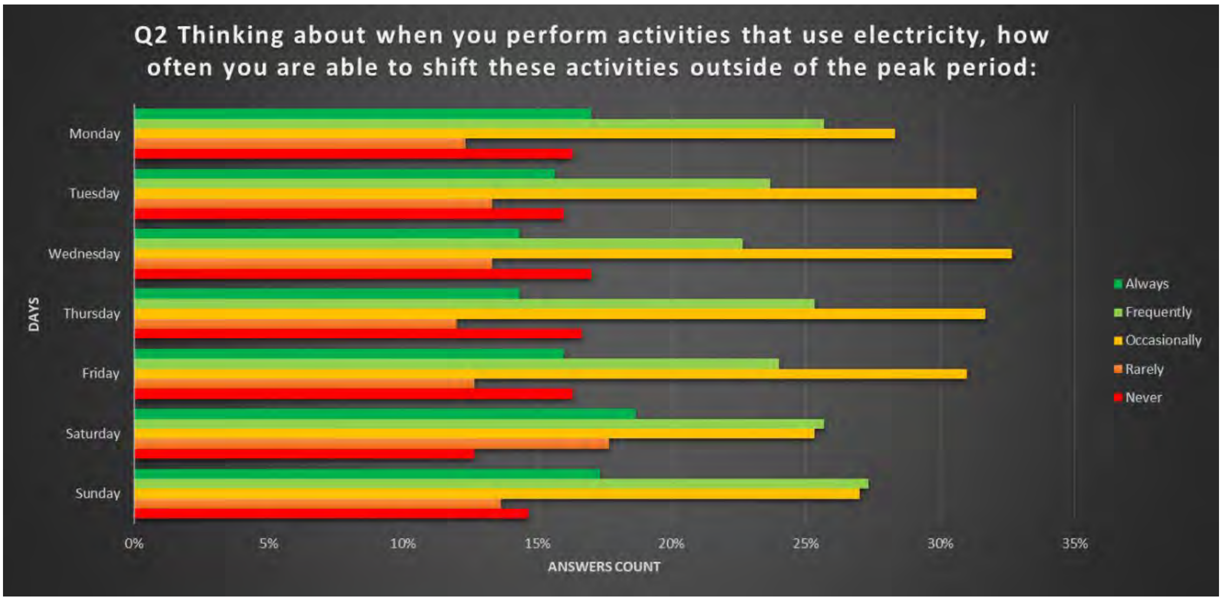


Figure 2 Q2: Thinking about when you perform activities that use electricity, how often you are able to shift these activities outside of the peak period:

Figure 2 shows customers behaviour on a weekly basis. From Monday to Friday, 30% of customers shifted their appliances usage "*occasionally*", 24% shifted the usage "*frequently*" from the peak time, and just 15% of them shifted the usage "*always*", while 16% "*never*" shifted the usage on weekdays.

During the weekend, the effort is higher: it can be noticed that 18% of customers shifted their usage "*always*" (3% higher than on weekdays), 27% shifted their usage from the peak time "*frequently*", while 14% "*never*" shifted appliances usage during the weekend (2% less than on weekdays).

A similar trend has been seen in the LCL customers survey, where customers have hardly changed their habits on weekdays, whilst the effort to shift their usage from the peak time is higher at the weekend.

Figures 3 and 4 show customers response to the question: *"which of the following appliances were you able to avoid/delay during the peak period?"*

Consistent to question 1 the most delayed/avoided appliances (figures 4 and 5) are associated with washing related activities with appliances including: washing machines, dishwashers and tumble dryers. This is again consistent with results from LCL.

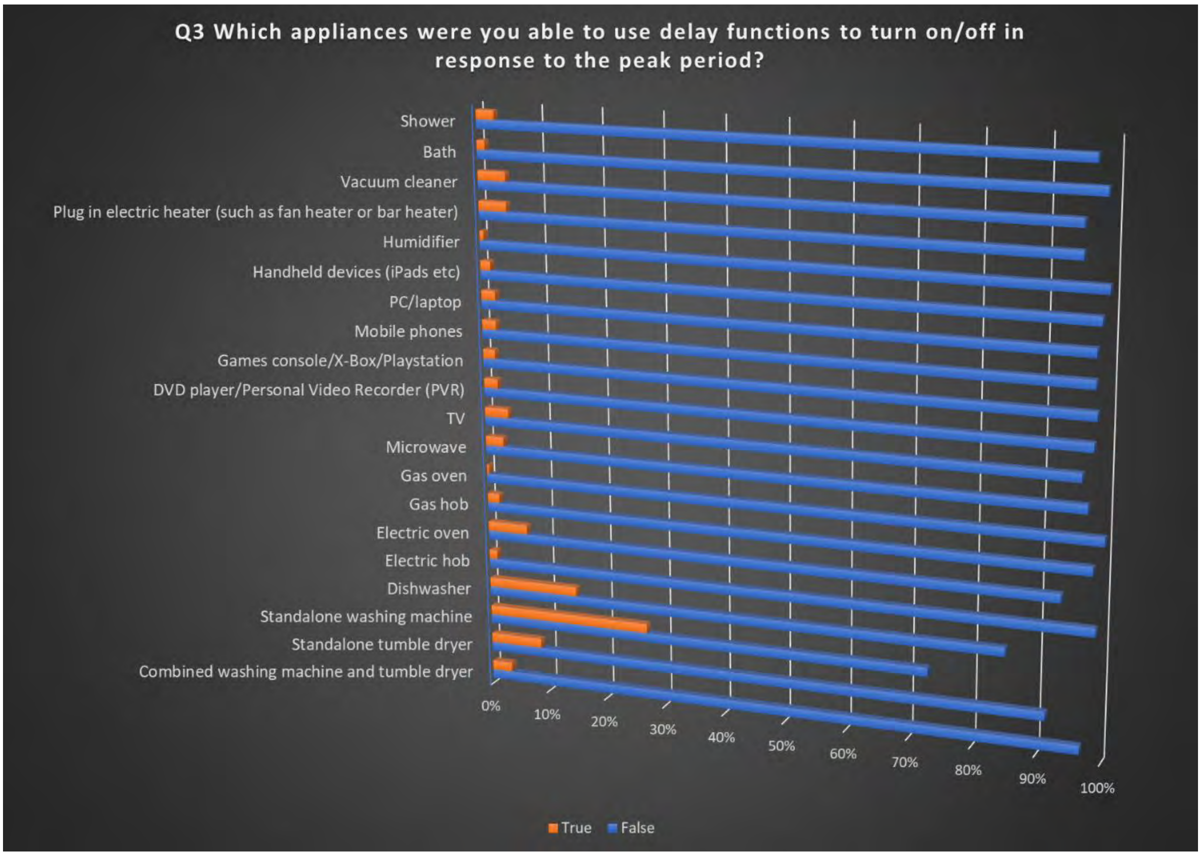


Figure 3 Q3: Which appliances were you able to use delay functions to turn on/off in response to the peak period?

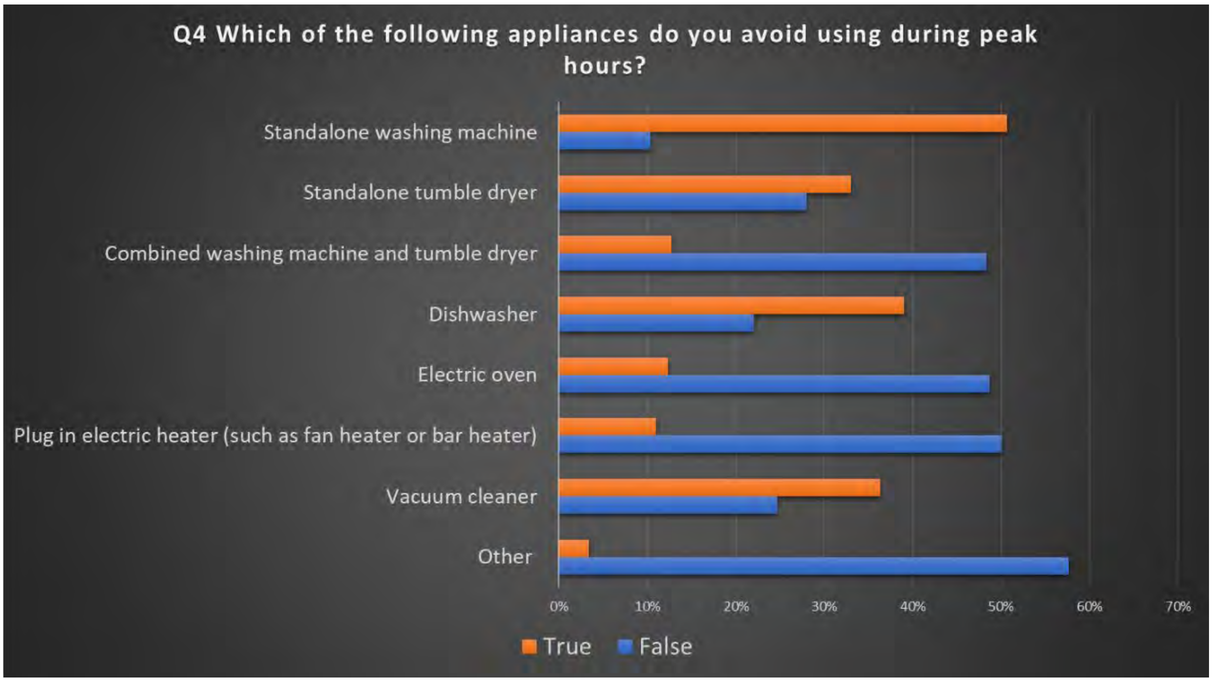


Figure 4 Q4: Which of the following appliances do you avoid using during peak hours?

In question 5 (figure 5) customers were asked: *To what extent do you agree or disagree that the following has limited your ability to use less electricity during the peak period?* Most people did not cite any clear barriers to shifting consumption. The main barrier identified was around both comfort levels and routines. This may indicate solutions which could support these factors i.e. insulation or learning equipped technology could be well placed to support further shifts in demand.

Figure 5 Q5: To what extent do you agree or disagree that the following has limited your ability to use less electricity during the peak period?

Engagement techniques

During the trial, different communication methods were used to remind/inform the participants about the incoming peak period and the need to shift the energy usage. Question 6A asked "*How helpful have you found the following to reduce consumption during peak periods?" and* question 6B asked *"Which method of communication did you find most useful in helping you to reduce energy consumption in the project?"*

The graph in figure 6A shows a positive response to emails, postal messages, and promotional materials. It is noticeable that 48% of customers did not know or did not watch the projects video on YouTube, as well as 36% of them stated that the video was not helpful.

Question 6B in figure 7 shown that postal messages are the most effective method, followed by emails and text messages.

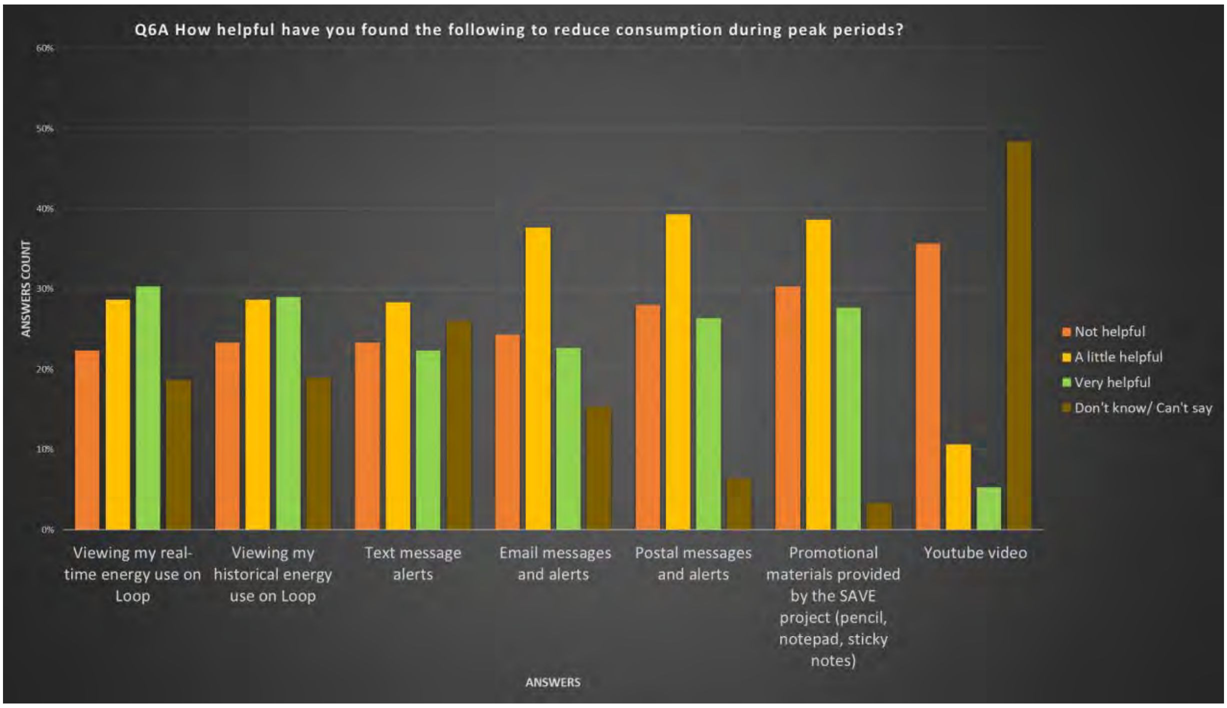


Figure 6 Q6A: How helpful have you found the following to reduce consumption during peak periods?

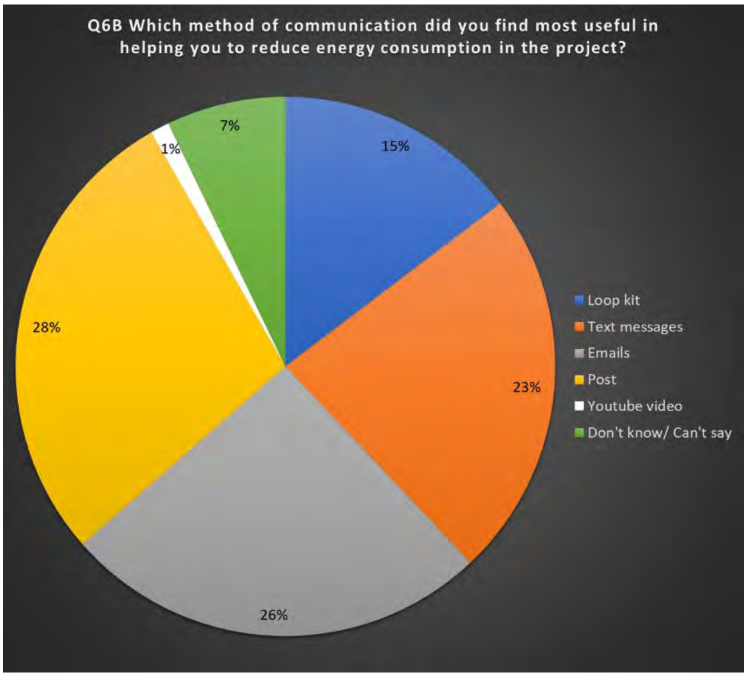


Figure 7 Q6B: Which method of communication did you find most useful in helping you to reduce energy consumption in the project?

Customers opinion

Question 7 asked which of the actions described in figure 8 would help in the future to reduce consumption during the peak period. The majority suggested that the loop system should show a traffic light system to make them visualize the best time to run appliances. Better information should be conveyed through a messaging system, and finally, it would also be useful for customers to be aware of their consumption through a display (smart meter).

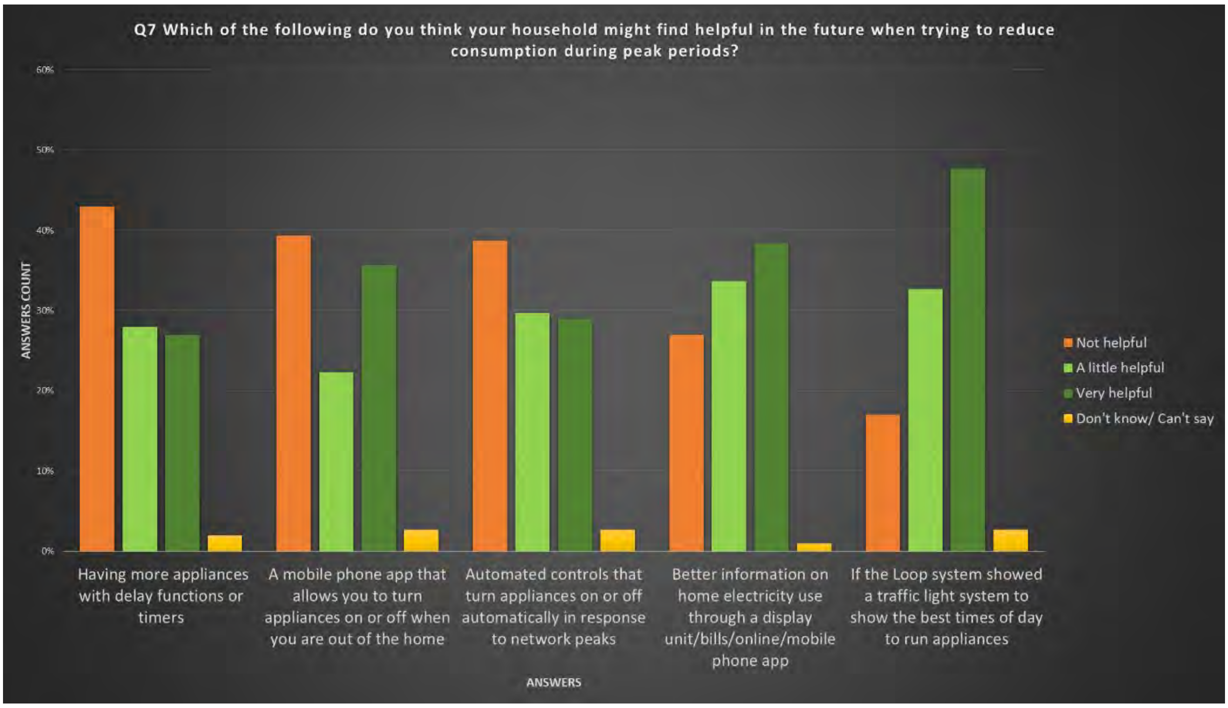


Figure 8 Q7: Which of the following do you think your household might find helpful in the future when trying to reduce consumption during peak periods?

Question 8: *If you were offered a similar peak rebate programme, how would the possible variations affect your interest in signing up?*

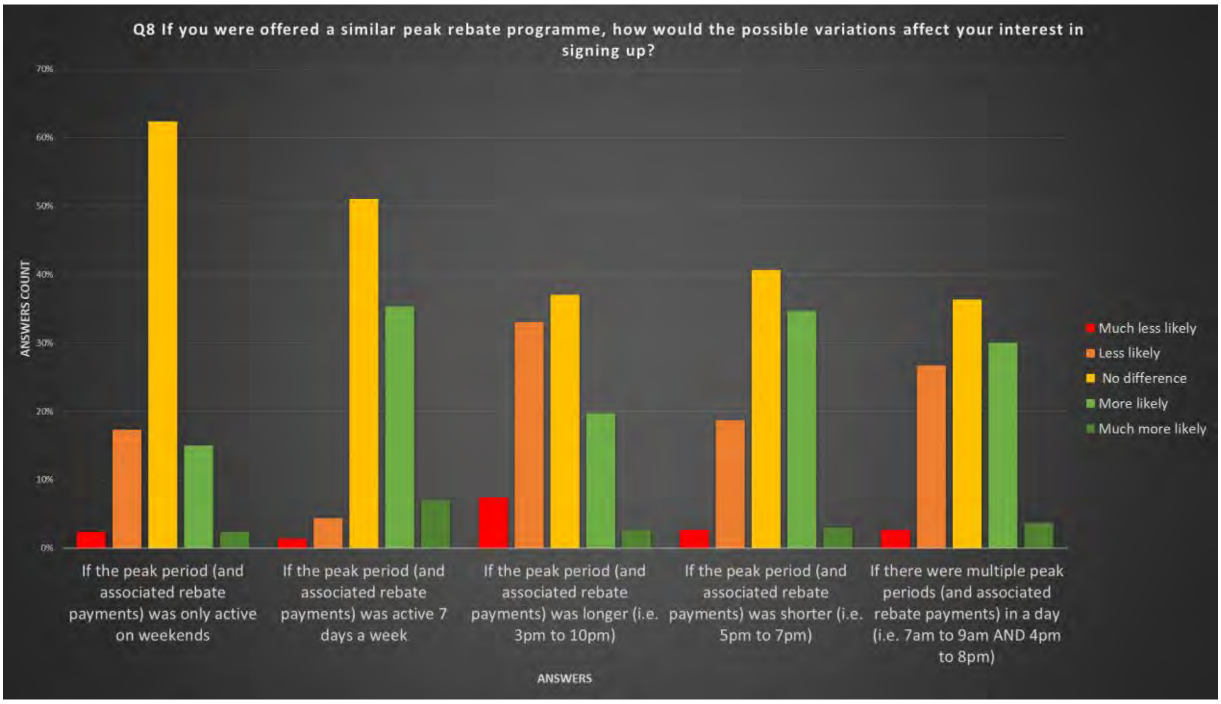


Figure 9 Q8: If you were offered a similar peak rebate programme, how would the possible variations affect your interest in signing up?

Figure 9 shows that customers would opt for a shorter peak period (5pm to 7pm) rather than a longer peak period (3pm to 10pm). This is consistent with trial response to event days which showed an increased load-reduction for shorted events. Interest in joining a rebate programme would also be more effective if the peak period was active 7 day per week rather than on weekdays only. As shown in figure 2, customers are keener on shifting energy usage during the weekend, drawing on learning from figure 5 around routines as a blocker, this is perhaps because the majority of 'Monday-Friday' workers do not see the same 'routine' based barriers on weekends as they do weekdays.

The following question inquired why the customers would like to be involved again in a similar energy project making them reflect on the surrounding environment / society. Question 9 asked: *If you were offered a similar peak rebate programme, which of the following would describe your motivations for signing up?*

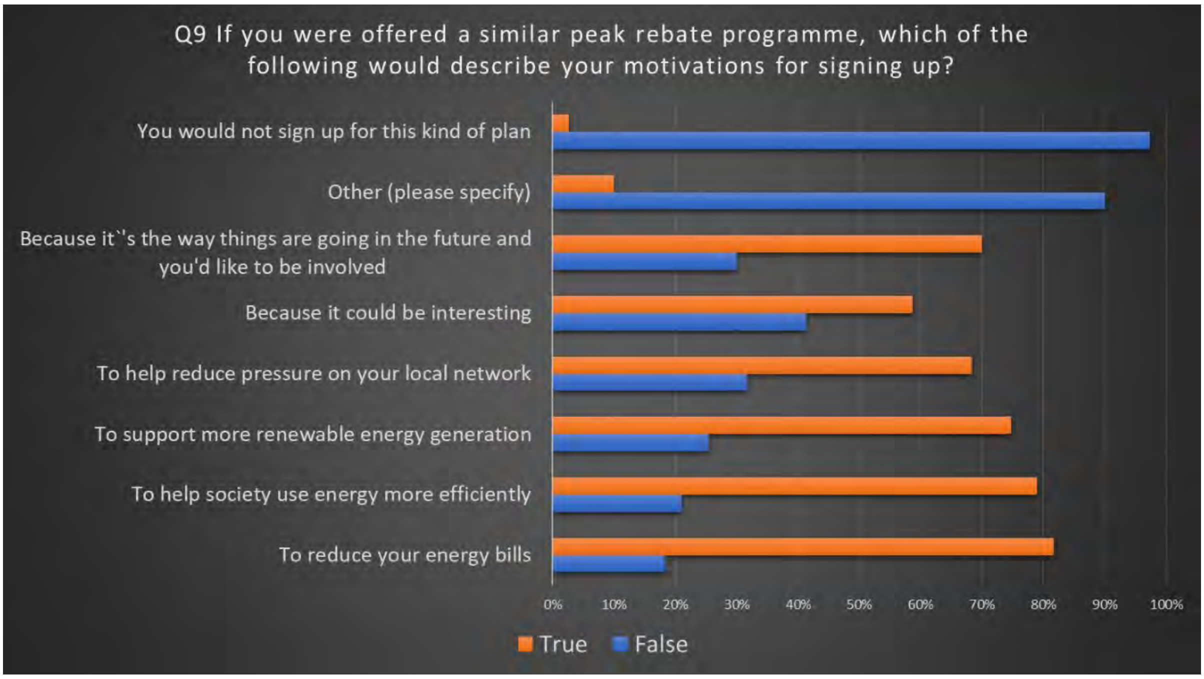


Figure 10 Q9: If you were offered a similar peak rebate programme, which of the following would describe your motivations for signing up?

The graph in figure 10 shows that the main reasons why people join a dynamic pricing rebate are probably cost, society, and environment. The majority of customers would sing up in a similar project to reduce energy bills and to help society, to support more renewable energy production, as well as to be involved in the future of energy.

Question 10 looked to explore customers response to their experience after participating in the SAVE trials. The results are shown in figure 11 below.

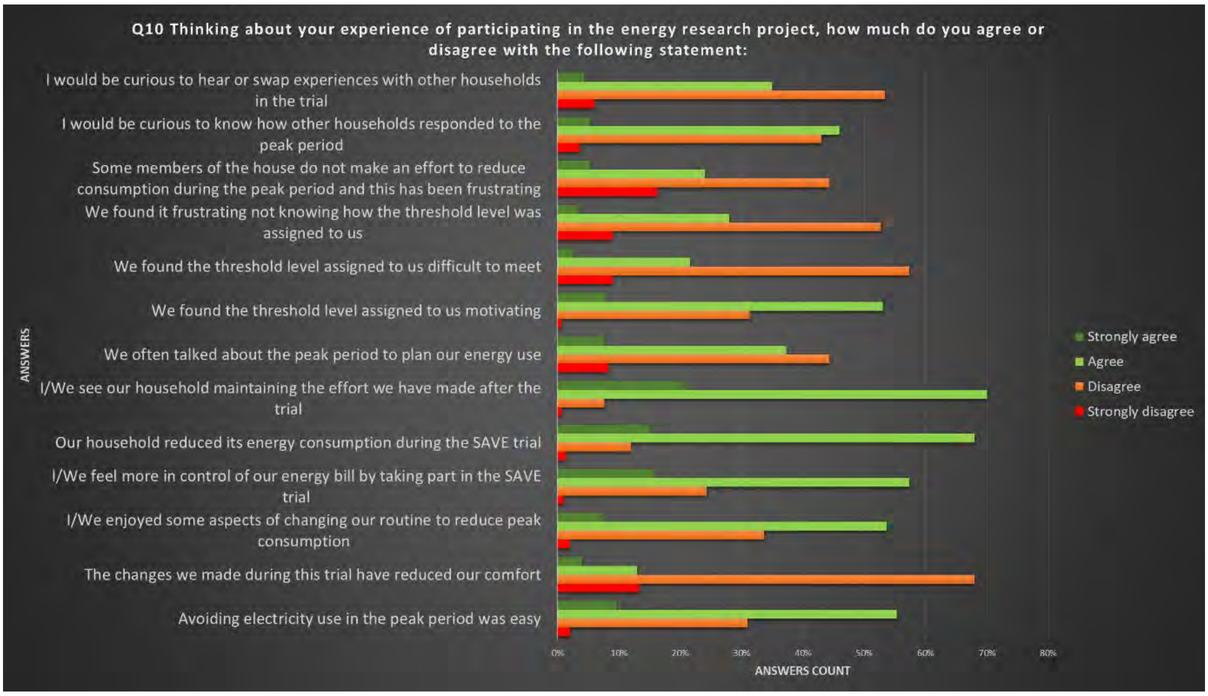


Figure 11 Q10: Thinking about your experience of participating in the energy research project, how much do you agree or disagree with the following statement:

Results show in general people felt they had reduced energy usage through becoming part of SAVE and that this was something that would be maintained after the project. More than half of customers enjoyed some aspects of changing routine to reduce the peak. Specific to the peak banded trial and of use to future dynamic pricing trials half of customers noted they found having a threshold assigned to them motivating.

Appendix 9.4 SAVE DNO Roadshow Feedback

The SAVE project team organised a series of roadshows to provide training in the Network Investment Tools capabilities and integration opportunities with different DNO organisation structures.

The following analysis shows the results obtained from a feedback form that the roadshow attendees filled out at the end of each roadshow.

The roadshows took place in at: NPG, UKPN and SHEPD. Each DNO was offered a tailored agenda focused on the network investment tool with the option for 'bolt-on' discussions around SAVE's trial outputs (energy efficiency, price signals, nudge messaging etc.) Attendees varied across DNO's from strategic higher management to network planners, designers and connections quoters to field operatives and stakeholder engagement teams.

A feedback form was given out to improve future dissemination and to evaluate the attendee's endorsement. The first two questions in Figure 1 enquired around quality and impact of the presentation and discussion; the third question allowed attendees to provide open feedback on the learning acquired through the session (Table 1). The final question asked attendees to highlight key words that summarised their view on what they'd heard on the project (Figure 2). The full feedback form is shown in the appendix.

Presentation and discussion rating:

The first two questions asked participants to rate if the presentation was relevant for their role and if the presentation and discussion were well structured. The attendees gave a score on a 4 point scale from *strongly disagree,* to *strongly agree*. The graph below shows the answers in percentage for both questions (note no respondees noted a response of 'disagree' or 'strongly

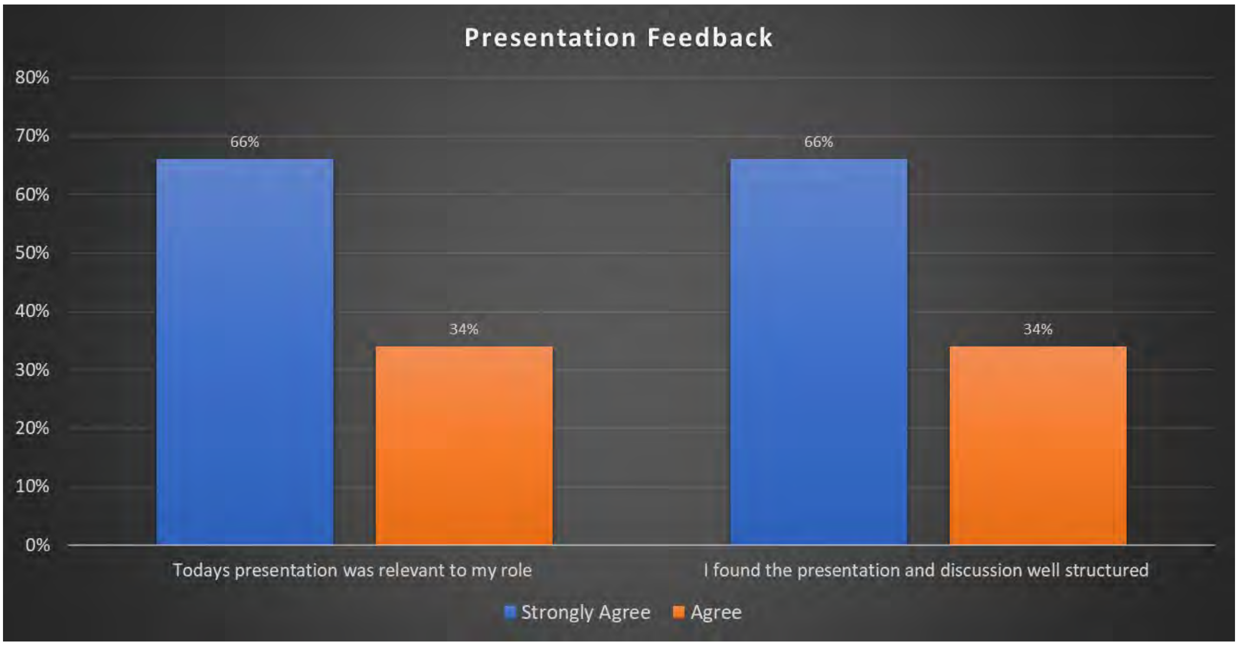


Figure 1 Presentation Feedback results

From the above graph, it is possible to notice that two-thirds of participants both found topics discussed very relevant (strongly agree) and very well structured (strongly agree)

Key feedback quotes:

Table 1 below shows the open answers that the attendees left on the feedback form. The question asked: "If relevant, how could you use the learnings from today within your business area?"

Who	Quote
UKPN, Innovation	The learning from the presentation could be used for BaU transition and for new projects about energy efficiency. DNOs could deploy the SAVE intervention in RIIO2
UKPN, Flexibility Market	The SAVE intervention would be useful for flex services for LV network and as ways of engagement with DER
UKPN, Innovation	The NIT could be used to create a better CBA (cost benefit analysis)
SHEPD, Asset Management	The NIT is something that can influence where targeting resources in the future
SHEPD, Connections	The NIT can be used in new connection going forward. It can be useful tool in determine customer types through the census interface
SHEPD, Networks	As IT develops, the NIT will have a good potential to aid connections and network development.

Table 1 What participant have said about SAVE and NIT

Overall opinion:

Figure 2 shows the overall opinion about the roadshows, for which the attendees selected 4 words that best illustrate their opinions about the session attended.

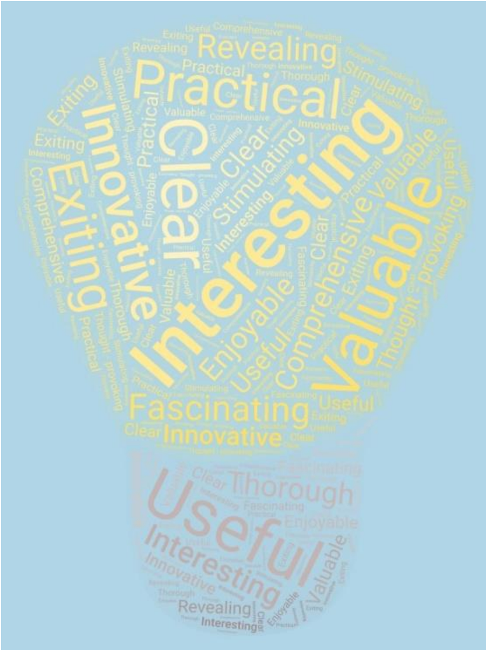


Figure 2 Roadshow overall opinion

Dissemination Feedback Form:

SAVE DNO Road Show

How did we do?

SAVE

Solent Achieving Value from Efficiency

Scottish and Southern Electricity Network (SSEN), thank you for this opportunity in presenting the findings generated from the Solent Achieving Value from Efficiency (SAVE) Project.

To help us improve future disseminations could we ask for your feedback on todays event?

What is your business area?

Todays presentations were relevant to my role.	1	Strongly Disagree	2	Disagree	3	Agree	4	Strongly Agree
I found the presentations and discussions well structured.	1	Strongly Disagree	2	Disagree	3	Agree	4	Strongly Agree

If relevant how could you use the learnings from today within your business area?

Please circle up to four words below that best sum up your overall opinion of todays experience.

interesting challenging exciting

nothing new revealing fascinating entertaining

boring confusing difficult rushed

thorough basic clear easy

realistic practical Theoretical exhausting

stimulating irrelevant useful new

innovative complicated comprehensive lifechanging

unfocussed enjoyable valuable inspiring

waste of time over ambitious thought-provoking

Thank you for your feedback! Its gratefully appreciated!

Scottish & Southern Electricity Networks

Solent Achieving Value from Efficiency

Appendix- 9.5
SAVE closedown event – Central Hall, Westminster

Agenda and location information pack

6 June 2019

LCN Fund
Low Carbon Networks

Scottish & Southern Electricity Networks

SAVE closedown event

Scottish and Southern Electricity Networks

Solent Achieving Value from Efficiency

Scottish and Southern Electricity Network (SSEN) SAVE project team welcome you to Central Hall, Westminster for today's dissemination event.

The Solent Achieving Value from Efficiency (SAVE) project is part of a wider UK programme funded by the Low Carbon Network Fund (LCNF) run by Ofgem, the UK regulator. LCNF supports projects sponsored by the Distribution Network Operators (DNOs) to try out new technology, operating and commercial arrangements. The aim of the projects is to help all DNOs understand how they can provide security of supply at value for money as Britain moves to a low carbon economy.

SAVE sought to establish to what extent energy efficiency measures can be considered as a cost effective, predictable and sustainable tool for managing peak demand as an alternative to network reinforcement.

SAVE tested and compared the impact of four different interventions with 8,000 Solent customers: Energy efficiency; Education; Monetary incentives; and Community engagement. By fusing smart technologies, with customer interaction, SSEN has developed a model for investment that minimises electricity cost for customers, maximises social benefits, including those to the fuel poor and vulnerable, and reduces carbon emissions.

The Project Team have broken the learnings, taken from running the project, into workshops. The agenda below details how the day will run and how we propose to share the learnings with you.

SAVE Closedown event (Central Hall)		Room 1		Room 2	
0845 - 0900		Registration			
0900 - 0930		Welcome: SAVE Project Methodology			
Session 1	0935 - 1000	Project Setup	Customer Recruitment	Monitoring & Analysis	Understanding your substation / feeder
Session 2	1005 - 1030		Trial Design		Trial Evaluation
1030 - 1045		Break			
Session 3	1045 - 1110	Managing the Network	Customer Modelling	SAVE Outputs	Marketing / Nudge Techniques
Session 4	1115 - 1140		Network Modelling		Regulatory / Policy impact
Session 5	1145 - 1210		Network Investment Tool		Commercial Cores
1210 - 1255		Lunch			
Session 6	1300 - 1325	SAVE Outputs	LED's	Customer Engagement	Data and Price Signals
Session 7	1330 - 1355		Price Signals		Community Coaching
1400 - 1445		BaU Delivery and Wrap up			

Scottish & Southern Electricity Networks

SAVE closedown event – Session brief

Scottish and Southern Electricity Networks

Solent Achieving Value from Efficiency

SAVE project methodology

Presenting: Charlie Edwards, Scottish and Southern Electricity Networks.

Spanning five years of research and £10 million in investment, the SAVE project spans a huge breadth of trials and DSO centric topics. The events introductory presentation will give a summary of the project structure, including trial methodologies, the data feeding directly into a series of industry applicable models and a series of spin-off reports and work packages commissioned to support Business as Usual delivery of the projects key outputs.

Project Setup: Customer Recruitment

Presenting: Dawn Hands, BMG Research.

An overview of customer recruitment and engagement. This presentation will discuss aspects of customer recruitment including the meticulous planning and coordination required during set-up, maximising response rates, challenges faced during fieldwork as well as how these were overcome. This presentation also describes ongoing engagement and attrition levels and what was done to maintain project participant volumes.

Project Setup: Trial Design

Presenting: Elizabeth Steele, DNV GL.

An overview of the setup and structure of SAVE's three trials monitored at household level, namely energy efficiency, data informed engagement and price signals. This presentation will describe the design process for each of these trials, the reasons they took the format the format they did (including a draw on learning from other LCNI projects) the hypotheses they looked to inform.

Monitoring and Analysis: Understanding your substation and feeder

Presenting: Tom Rushby and Patrick James, University of Southampton.

An overview of the electricity monitoring implemented during the SAVE project trials. This presentation will describe the feeder-level monitoring of electricity consumption and it's use to evaluate the impact of the SAVE community energy coaching trials. We will show analysis of trial events and how feeder-level monitoring can help DNOs to better understand vulnerable assets.

Scottish & Southern Electricity Networks

SAVE closedown event – Session brief

Scottish and Southern Electricity Networks

Solent Achieving Value from Efficiency

Monitoring and Analysis: Trial Evaluation

Presenting: Tom Rushby, University of Southampton.

A core part of the SAVE trials set out to test a number of interventions aimed at reducing household demand during the peak-hours of domestic load. This presentation will provide a summary of the randomised controlled trial experimental design and the techniques used to evaluate the SAVE household trials. We will describe the SAVE sample and recruitment outcomes, the household level data and the techniques employed to evaluate the response to the SAVE interventions.

Managing the Network: Customer Modelling

Presenting: Tom Rushby, University of Southampton.

This presentation will describe the use of data collected under the SAVE project to provide two key inputs for the Network Model and Network Investment Tool: customer demand profiles and intervention impact profiles. We will describe the generation of these inputs through the Customer Model with the use of a customer typology and application to network modelling using small-area Census statistics.

Managing the Network: Network Modelling

Presenting: Paul Morris, EA Technology.

"Network Modelling allows network planners to assess the impact of load growth and low carbon technology uptake on LV and HV networks. Network Model, using SAVE data and key outputs, simulates the real-time operation and management of electricity distribution networks and calculates at what point in time a network under investigation would reach the limit of its capacity across a number of different load growth scenarios and different capacity interventions."

Managing the Network: Network Investment Tool

Presenting: Maciej Fila, Scottish and Southern Electricity Networks.

The Network Investment Tool is the cumulation of SAVE's three models, the customer model, the network model and the pricing model. Using an amalgamation of project data and key outputs this tool provides software allowing a planner to forecast both current and future consumption on their network (based upon census information and types of customer) and run a series of load-flows to determine the most cost-effective solutions to manage foreseeable constraints.

Scottish & Southern Electricity Networks

SAVE closedown event – Session brief

Scottish and Southern Electricity Networks

Solent Achieving Value from Efficiency

SAVE Outputs: Marketing and Nudge Techniques

Presenting: David Hall , DNV GL.

This session will present the engagement methods and delivery mechanisms used on the SAVE project. This will include a detailed view of the behavioural science insights used in each engagement method as well as how the project used postal, digital, email and text communication to interact with customers.

SAVE Outputs: Regulatory and Policy Impact

Presenting: Elizabeth Steele, DNV GL.

DNV GL reviewed published regulation, policies and literature on other energy efficiency schemes to understand opportunities and barriers to business as usual DNO deployment of SAVE methods

SAVE Outputs: Commercial Cores

Presenting: Helen Snodin and Jacopo Torriti, CAG Consultancy.

A presentation on the latest results from 'Core capacity – an investigation of SAVE data' looking at the socio-economic factors influencing consumers' capacity requirements, their ability to flex energy use, and the social science literature on essential energy requirements. The work is being conducted in tandem with research for Citizens Advice on core capacity, to feed into Ofgem's future charging review.

SAVE Outputs: LED's

Presenting: Charlie Edwards, Scottish and Southern Electricity Networks.

An overview of SAVE's energy efficiency based engagement method, centred around LED bulbs. We will describe the lessons learned around customer engagement with regards to energy efficiency engagement as well as laying a blueprint for successful rollout of LED lighting and the benefits this can bring for DNOs, customers and the environment.

Scottish & Southern Electricity Networks

SAVE closedown event – Session brief

Scottish and Southern Electricity Networks

Solent Achieving Value from Efficiency

SAVE Outputs: Price Signals

Presenting: Charlie Edwards, Scottish and Southern Electricity Networks.

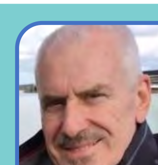
SAVE's final trial period looked at a uniquely designed dynamic price signal termed 'peak banded pricing'. The project team will give an overview of the design of this mechanism, means of communicating with customers, impacts of different price levels on consumption and what this tells us for the worlds of flexibility, tariffs and network charging mechanisms.

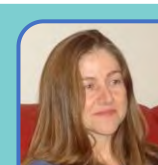
Customer Engagement: DATA and Price Signals

Presenting: Elizabeth Steele , DNV GL.

This session will walk through the design process of the data informed engagement trials in the first two trial periods. We will present initial focus group research and how this informed both the campaigns encouraging customers to 'shift' and 'cut' their consumption during the peak period. We will also present high-level results from these trials.

Customer Engagement: Community Coaching





Presenting: John Every and Judi Sellwood, Neighbour Economics.

This community level trial explored the potential impacts of direct collaboration with communities and other key stakeholder agencies to embed peak demand reduction within local well-being strategies. The team has identified vital community engagement lessons which can improve the depth and sustainability of local impacts, especially in less resilient communities. We will also look at how the idea of creating 'stackable benefits' for stakeholders can add value to business as usual strategies.

Business as Usual Delivery and Wrap up

Presenting: Charlie Edwards , Scottish and Southern Electricity Networks.

To close the days initial event, the project team will provide a wrap up session of some of the days key project learning and how what has been discussed is being directly implemented into SSEN's business as usual strategy, including Social Constrained Managed Zones. This session will provide a 25 minute time slot for unanswered Q and A from across the days presentations.

Scottish & Southern Electricity Networks

SAVE closedown event – Location

Scottish and Southern Electricity Networks

SAVE

Solent Achieving Value from Efficiency

Getting to the event

Getting to Central Hall Westminster couldn't be easier. The building overlooks Westminster Abbey, Big Ben, and the Houses of Parliament, in one of central London's most prestigious and iconic locations.

Central Hall is a short walk from several underground and rail stations, and also served by multiple buses. Local car parking is also nearby if you are planning to travel to us by car.

Postcode location:
Central Hall Westminster, Storey's Gate, London, SW1H 9NH

From the Airport

Central Hall Westminster can be easily accessed from all London airports.
Heathrow, Gatwick, City, Stansted, and Luton airports all operate express shuttles and rail services that travel into central London, from where you can get to us directly or change to another mode of transport.

By Car

Our building is located within the central London Congestion Charge zone. If you are driving to us, you can park your vehicle in one of several public car parks, located nearby in:
- Abingdon Street
- Horseferry Road
- Rochester Row
- Semley Place

There is also public parking adjacent to our building, on Tothill Street and Matthew Parker Street.

By Bus

We are served by several bus routes, many of which pass directly outside our building.
- Buses 11, 24, 148 and 211 pass our door
- Buses 3, 12, 53, 53X, 87, 88, 109, 159 and 453 stop nearby.

By London Underground

You can get to Central Hall Westminster using multiple modes of transport.
We are within easy walking distance of three underground / tube stations:
- Westminster station (Jubilee, Circle and District lines) – 3 minute walk
- St James' Park station (Circle and District lines) – 3 minute walk
- Victoria station (Victoria, Circle and District lines) – 13 minute walk

You can also visit the Transport for London site for additional help on planning your journey on the London Underground network.

By Rail

We are within easy walking distance of three mainline rail stations:
- Victoria rail: 13 minute walk
- Charing Cross rail: 14 minute walk
- Waterloo rail: 18 minute walk

You can also visit the National Rail or the TrainLine for additional help on planning your journey using the rail network.

Scottish & Southern Electricity Networks

Partners

University of Southampton Academic partners on the SAVE project providing analytical rigour and expertise alongside development of the customer model.

DNV GL Consultant partners on the SAVE project providing industry leading expertise to feed in to trial design and project reporting.

Neighbourhood Economics Social purpose consultancy and lead on SAVEs community energy coaching trials, neighbourhood economics bring expertise and leadership in community engagement.

BMG Research Project supplier providing customer recruitment and engagement expertise throughout the project.

Trust Power Project supplier providing electricity monitoring equipment and maintenance to the project.

EA Technology Project supplier providing the network and pricing models to the project.

Future Solent Local Enterprise Partnership providing local expertise and support to the project's engagement activities.

SAVE closedown event – Portcullis House, Westminster

Agenda and location information pack

6 June 2019

SAVE closedown event

Scottish and Southern Electricity Networks

SAVE
Solent Achieving Value from Efficiency

Scottish and Southern Electricity Network (SSEN) SAVE project team welcome you to Portcullis House for today's dissemination event.

The Solent Achieving Value from Efficiency (SAVE) project is part of a wider UK programme funded by the Low Carbon Network Fund (LCNF) run by Ofgem, the UK regulator. LCNF supports projects sponsored by the Distribution Network Operators (DNOs) to try out new technology, operating and commercial arrangements. The aim of the projects is to help all DNOs understand how they can provide security of supply at value for money as Britain moves to a low carbon economy.

SAVE sought to establish to what extent energy efficiency measures can be considered as a cost effective, predictable and sustainable tool for managing peak demand as an alternative to network reinforcement.

SAVE tested and compared the impact of four different interventions with 8,000 Solent customers: Energy efficiency; Education; Monetary incentives; and Community engagement. By fusing smart technologies, with customer interaction, SSEN has developed a model for investment that minimises electricity costs for customers, maximises social benefits, including those to the fuel poor and vulnerable, and reduces carbon emissions

Todays event will provide a strategic overview of how SAVE feeds into the bigger picture of a Distribution System Operator (DSO) and UK energy markets.

The event will be Chaired by Alex Howison, Flexible Solutions Manager for SSEN.

SAVE Closedown event (The Houses of Parliament)		
Session 1	1530 - 1600	Networking / Arrival
Session 2	1600 - 1610	Welcome (MP)
Session 3	1610 - 1630	Introduction to SAVE
Session 4	1630 - 1700	Panel Session
	1700 - 1715	Break
Session 5	1715 - 1725	Presentation: BEIS
Session 6	1725 - 1735	Presentation: SSEN
Session 7	1735 - 1845	Transition to a Smarter Network
Session 8	1845 - 1900	Wrap up / Networking

Scottish & Southern Electricity Networks

SAVE closedown event – Session brief

Scottish and Southern Electricity Networks

SAVE

Solent Achieving Value from Efficiency

Welcome

Presenting: Dr Alan Whitehead MP - Shadow Energy Minister

Alan has been the Shadow Energy and Climate Change Minister since October 2016 and served as the Shadow DECC Minister for Generation and Transmission September 2015 – June 2016. During his time in office he has championed the development of a new decarbonised energy landscape. Since becoming the Labour MP for Southampton Test in 1997 Alan has served on the Select Committees for Environment, Transport and the Regions; Energy and Climate Change and Environmental Audit. He has a Ph.D. in Political Science from Southampton University.

Introduction to SAVE

Presenting: Charlie Edwards - SSEN

The SAVE Project Manager Charlie Edwards, will introduce the project's key learnings, and to what extent energy efficiency measures can be considered as a cost effective, predictable and sustainable tool for managing peak demand as an alternative to network reinforcement. Charlie will provide a background to the key drivers for the project, and how SSEN is developing its key learnings into products ready for the market.

Panel Session: SAVE Project Participants

Panellists: Charlie Edwards - SSEN, Elizabeth Steele - DNV GL, Judi Sellwood Community Development Worker - Neighbourhood Economics, Tom Rushby - Southampton University.

The first panel session of the evening will explore the participants' SAVE project experience. It will provide a spectrum of views in how the energy industry can improve its engagement with the communities it serves. Discussions will range from how the transition to a smarter network should be inclusive, how opportunities can be seized and maximised, and the lessons that can be applied across the UK energy system from the SAVE project

Scottish & Southern Electricity Networks

SAVE closedown event – Session brief

Scottish and Southern Electricity Networks

BEIS Presentation

Presenting: Sam Balch, Deputy Director, BEIS

Sam will give a BEIS view on challenges and opportunities for improving domestic energy efficiency in the context of a smarter grid, what actions the Government is taking in this space, and the role of energy efficiency in meeting the Government's climate change objectives.

Scottish and Southern Electricity Networks Presentation

Presenting: Andrew Roper, DSO Director, SSEN

DSO Director Andrew Roper presents the steps SSEN is taking in delivering a smarter, more flexible network, and the key principles that underpin this transition. He will explain how SSEN is embedding the priorities that the Energy Secretary set out in 2018, and the challenges that SSEN is addressing.

Transition to a Smarter Network (panel discussion)

Panellists: Peter Bingham - Ofgem, Adam Scorer - National Energy Action, Philip Sellwood - Energy Saving Trust, Randolph Brazier - ENA, and Andrew Roper - SSEN.

The proliferation of low-carbon technology and generation opens up opportunities for our customers to engage with the electricity system that serves them, in new and exciting ways. This panel will discuss what a smart network can deliver, and what a successful transition looks like for the UK energy system.

SAVE closedown event – Location

Scottish and Southern Electricity Networks

SAVE

Solent Achieving Value from Efficiency

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Portcullis House, 1 Parliament St, Westminster, London SW1A 2JR

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•Buses 3, 11, 12, 24, 53, 87, 88, 148, 159, 211, 453, N2, N3, N11, N87, N136, N155, N159 & N381 all stop Near by.

UNDERGROUND

By London Underground

You can get to Portcullis House using the underground.

We are within easy walking distance of the underground:

•Westminster station (Jubilee, Circle and District lines) – 3 minute walk

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Appendix 9.6- SAVE Closedown Event, SLIDO analysis report

The following report analyses the questions asked to the audience who attended to the SAVE project closedown event on the 6th of June 2019 in London.

The questions were asked using Sli.do which an audience interaction tool for meetings, events and conferences. The audience interacted with Sli.do using a web browser where they could choose between multiple answers or open answers. The questions are split into two sections: project related queries and event related feedback

Project Queries

Project trials

Question 1 asked: *Could Energy Efficiency be effectively deployed to manage networks?* Over three quarters of participants agreed energy efficiency could be deployed to manage networks with just 3% of participants noting energy efficiency would not be suitable for effective deployment in network management. SSEN are looking to further prove this through its SCMZ programme and joint utility working on LV transformers.

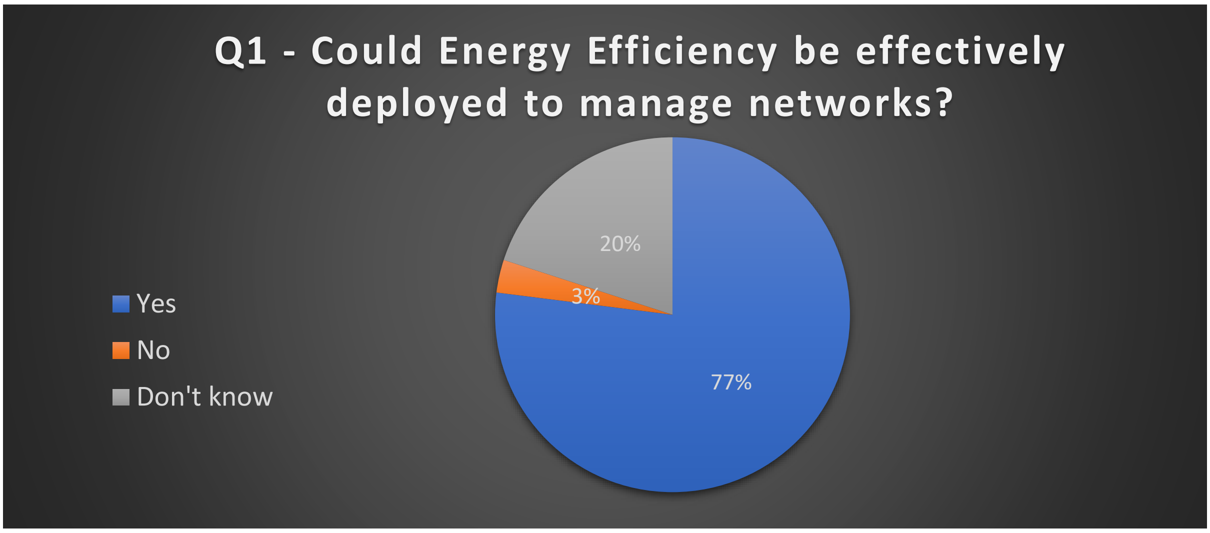


Figure 1 Could Energy Efficiency be effectively deployed to manage networks?

Question 2 asked the open question of: *"what are the biggest blockers to domestic customers supporting in network management?"* Responses are shown in figure 2 below. Figure 2 shows that the most common response cited by almost one quarter of people was cost as the biggest barrier to domestic customers supporting with network management. Understanding and Apathy also scored highly. This learning is crucial to supporting SSEN's SCMZ schemes.

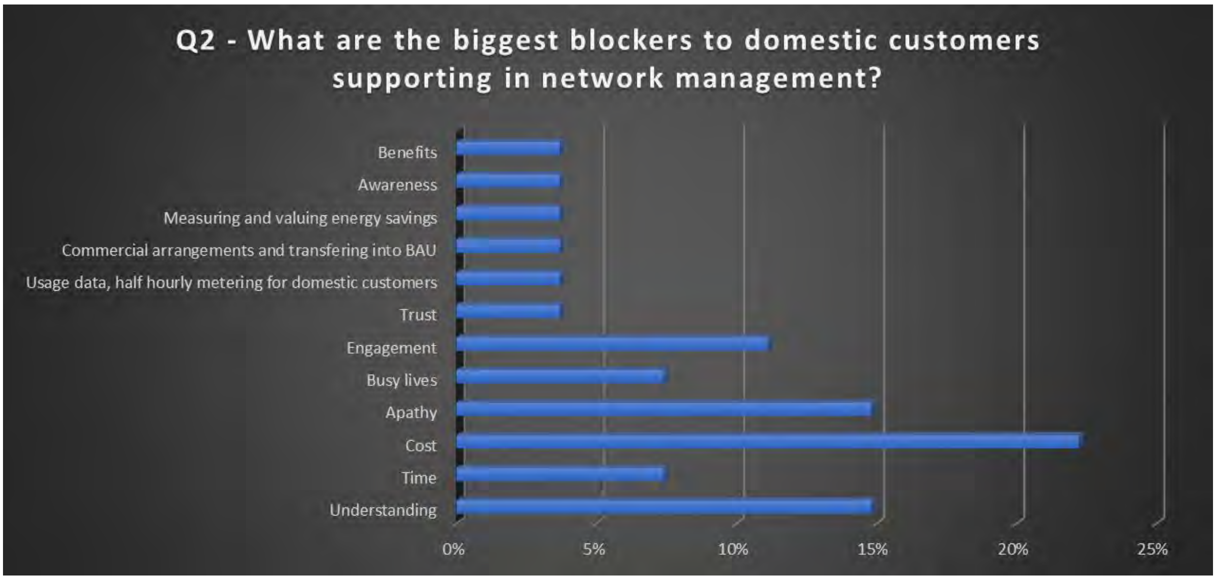


Figure 2 What are the biggest blockers to domestic customers supporting in network management?

Question 3 looked to explore whether *government should be doing more to support energy efficiency uptake.* Figure 3 shows an overwhelming majority (97%) thought the government should be doing more to support energy efficiency, perhaps highlighting the social value of energy efficiency that may not be fully recognised by the market alone.

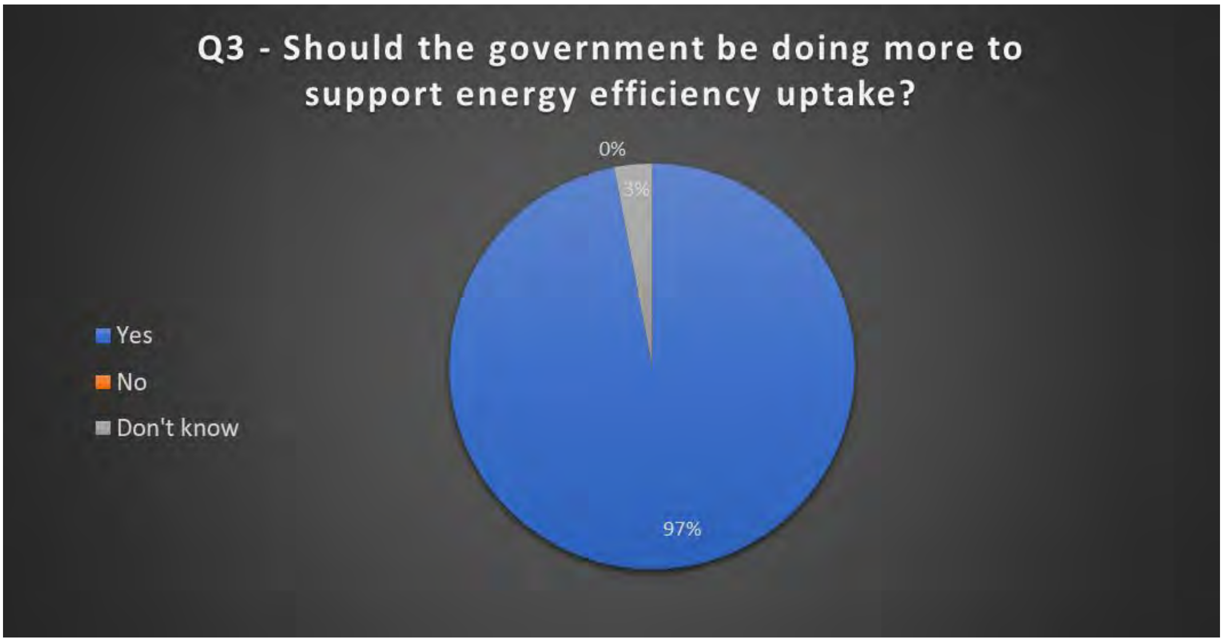


Figure 3 Should the government be doing more to support energy efficiency uptake?

Much like question 1, question 4 and 5 explored whether the more 'behaviourally focused' of SAVE's trials could be *"deployed as an effective flexibility solution for managing peak demand"* (question 4 frames behaviour change alone, whilst question 5 looks more at financial incentivisation). In both behavioural instances only a small percentage of respondents said 'no' there was far more uncertainty with behavioural initiatives alone than other solutions (energy efficiency, figure 1 or commercial incentives, figure 5). For behaviour change alone (figure 4) people were split between feeling it could be used in a flexibility context (48%) and being unsure (42%) people appeared to feel more comfortable in commercial incentives (figure 5) where 72% noted favour for managing peak demand and just 22% were unsure (compared to 77% and 20% for energy efficiency respectively). This is particularly interesting given SAVE's learning that financial incentives appear to have little additional effect to behaviour change alone.

Figure 4 Can behaviour change (i.e. nudge messaging) ever be deployed as an effective flexibility solution for managing peak demand?

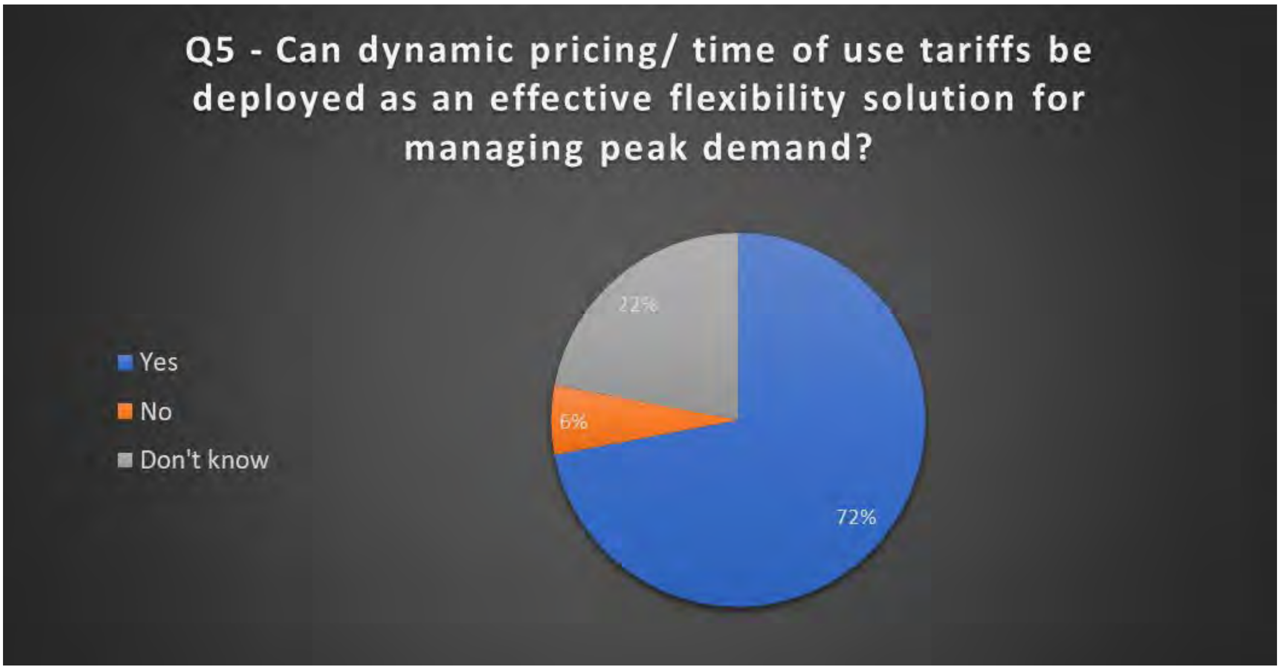


Figure 5 Can dynamic pricing/ time of use tariffs be deployed as an effective flexibility solution for managing peak demand?

Question 7 looked to understand, given the positive feedback to DDSR, especially energy efficiency whether DNO's should be leading on the delivery of energy efficiency in future given their geographic nature. In general responses in table 1 below largely talk of a joined up collaborative approach, not necessarily led by the DNO part certainly as part of it. Collaborators commonly mentioned included: other utilities, government, suppliers and councils.

Q7 - Should DNO's lead on future rollout of energy efficiency? And if so, to what degree?	
In association with suppliers	With changes to license condition!!
Yes you are the right people for eveyone to work with, retailers only get to own customers	Based on your point about shared engagement costs, I think it should be utility based but perhaps a consortium across gas network and electricity netwotk
It should be a collaboration with others including govt, suppliers, gdns	Government should be leading this, and shouldn't have done away with the Zero Carbon Homes policy
Collaboration	Engagement
It needs a coherent effort between Govt, DSO, utility companies etc.	DNOs are part of the picture. Suppliers and other agencies have a role to play. Coordination is crucial.
In partnership with third parties	More so than energy suppliers
Within their remit as DNOs	They should be a part of it, not alone.
Together with suppliers / councils / government	Government supported by DNOs
Depends on the policy incentives	Yes (8)

Table 1 Should DNO's lead on future rollout of energy efficiency? And if so, to what degree?

Community engagement

Question 6, 8, 9 and 10 looked to focus more on community and stakeholder engagement alongside the social benefits of DDSR initiatives.

Question 6 asked the open question of *Should social benefit through community engagement be better incentivised under RIIO 2?* Response to this question are given in figure 6 which shows over three quarters of people feeling that social initiatives should be better incentivised. Whilst there were a couple of instances of 'depends; no one outright felt that social benefits shouldn't be better incentivised.

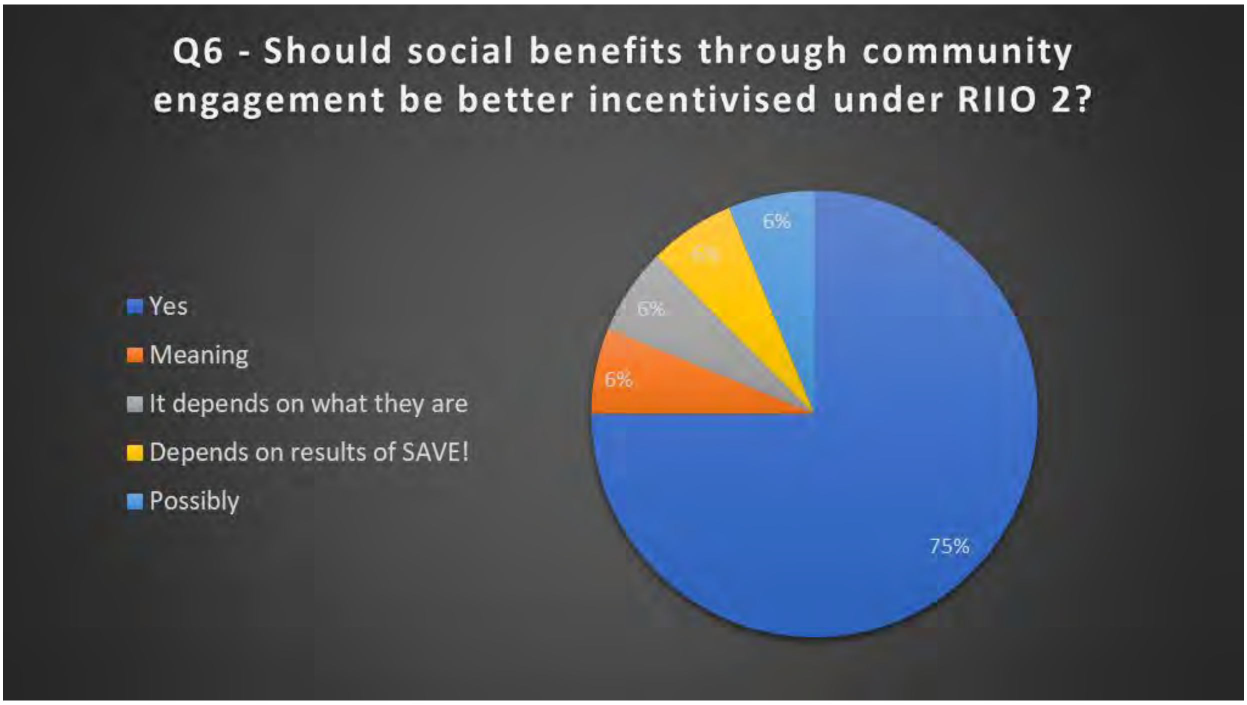


Figure 6 Should social benefits through community engagement be better incentivised under RIIO 2?

Question 8 progressed to ask another open question specific to the closedown events audience, namely Can you as a stakeholder organisation see ways in which you could improve efficiency through working with the DNO? And if so, how? Whilst responses to this question were limited generally responses were positive, albeit very varied as can be seen from table 2.

Table 2 Can you as a stakeholder organisation see ways in which you could improve efficiency through working with the DNO? And if so, how?

Q8 -Can you as a stakeholder organisation see ways in which you could improve efficiency through working with the DNO? And if so, how?	
Future role of the DNO as DSO needs further definition but in role yes	Yes but funding is required depending on network benefit
Yes, by having consistency across DNO regions	Collaboration in fuel poverty, wider sustainability
Two-way info exchange	Work together.
Yes, as delivery	It's all about charging mechanisms
Collaboration across DNO and shared learning	

Question 9 asked: *how should DNO's be engaging communities?* This question was closed with three options: as a lead partner, as a partner to DNO's shouldn't be engaging.

71% of the audience responded that DNO's should engage communities as a partner while 25% stated that it should engage it as lead partner while 4% responded that DNO shouldn't engage the community. Mirroring how people felt around DNO's delivering energy efficiency in question 7, the majority of people (71%) felt DNO's were an important partner but not necessarily a lead in community engagement (figure 7).

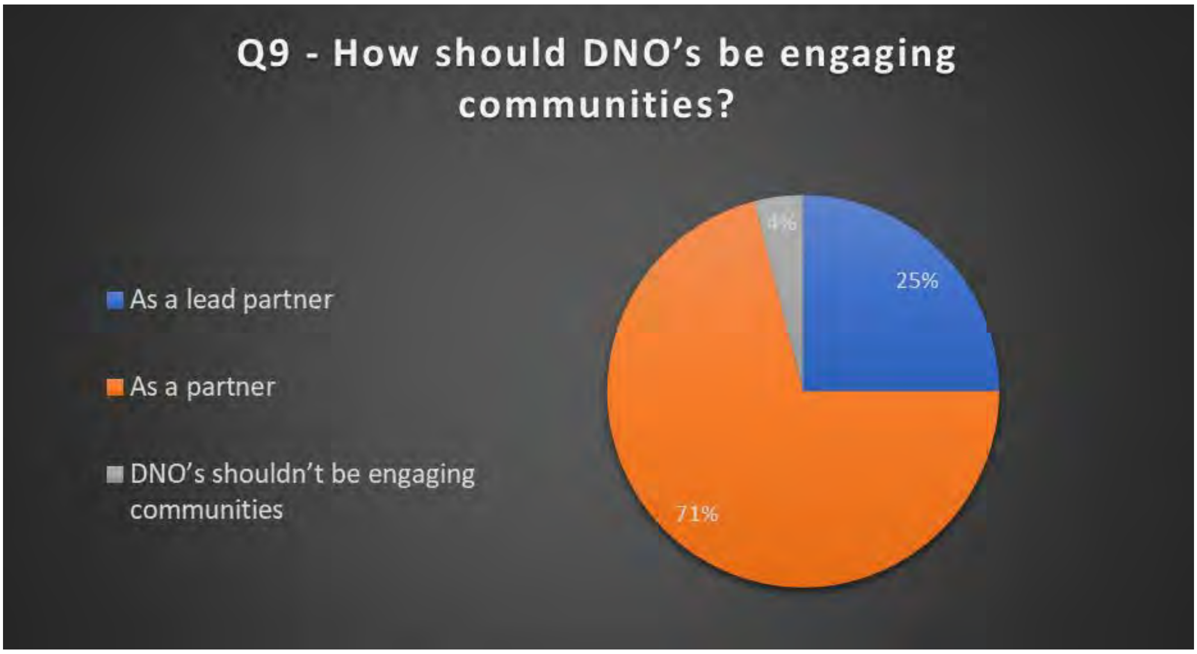


Figure 7 How should DNO's be engaging communities?

Building on question 9, question 10 asked, *who* (therefore) *should be engaging communities (with the DNO)?* Given the range of responses it is conclusive, from figure 8, with half of the respondents voting for local council delivery that there is a significant role for councils to play in engaging communities. This mirrors SAVE learning in their role as a trusted intermediary. A large percentage of the audience also noted 'other' which when probed further contained both suppliers and consumer advice groups (i.e. citizens advice).

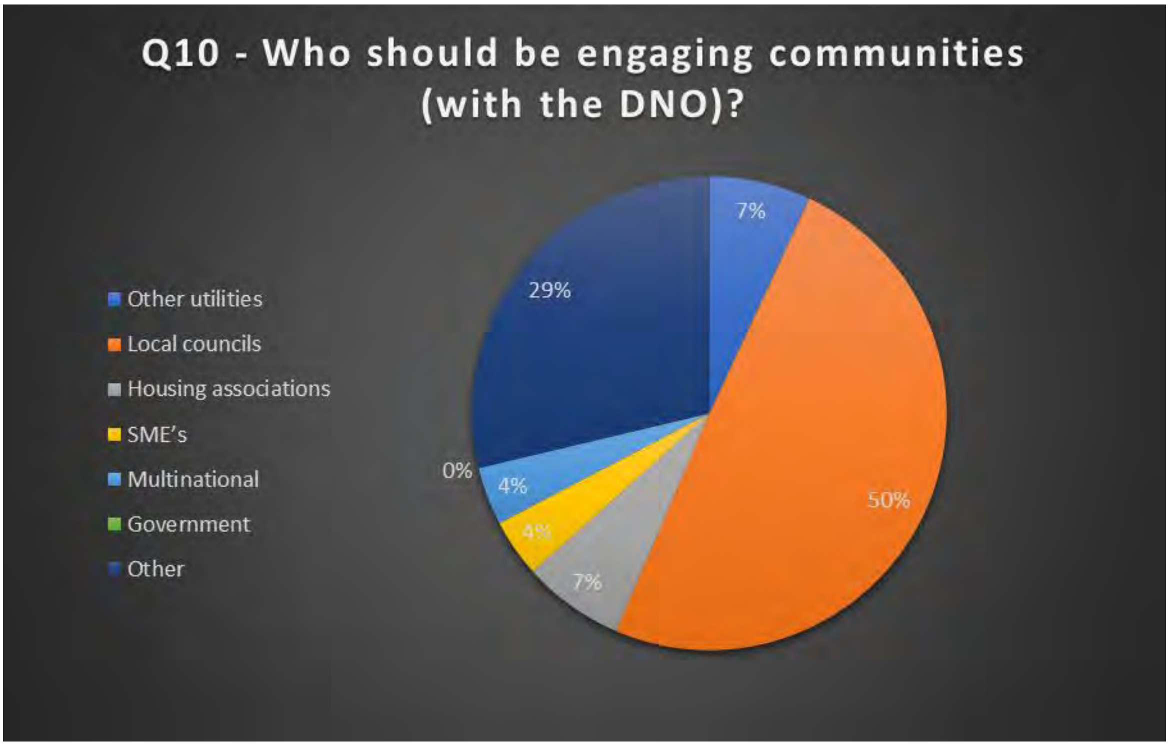


Figure 8 Who should be engaging communities (with the DNO)?

Network Investment Tool

Questions 11-13 focused on the NIT, looking at the value of the tool, namely to DNO's but potentially wider stakeholder too.

Question 11 queries whether the functionality of the NIT was deemed important for network investments. A large amount of the audience was unsure, potentially due to the technical nature of the tool, or the fact that the project had run parallel sessions all day so some people may not have been involved in earlier overview sessions around the NIT. That said only 1 respondent noted they did not see value in the NIT, whilst 10 indicated they did see value (figure 9).

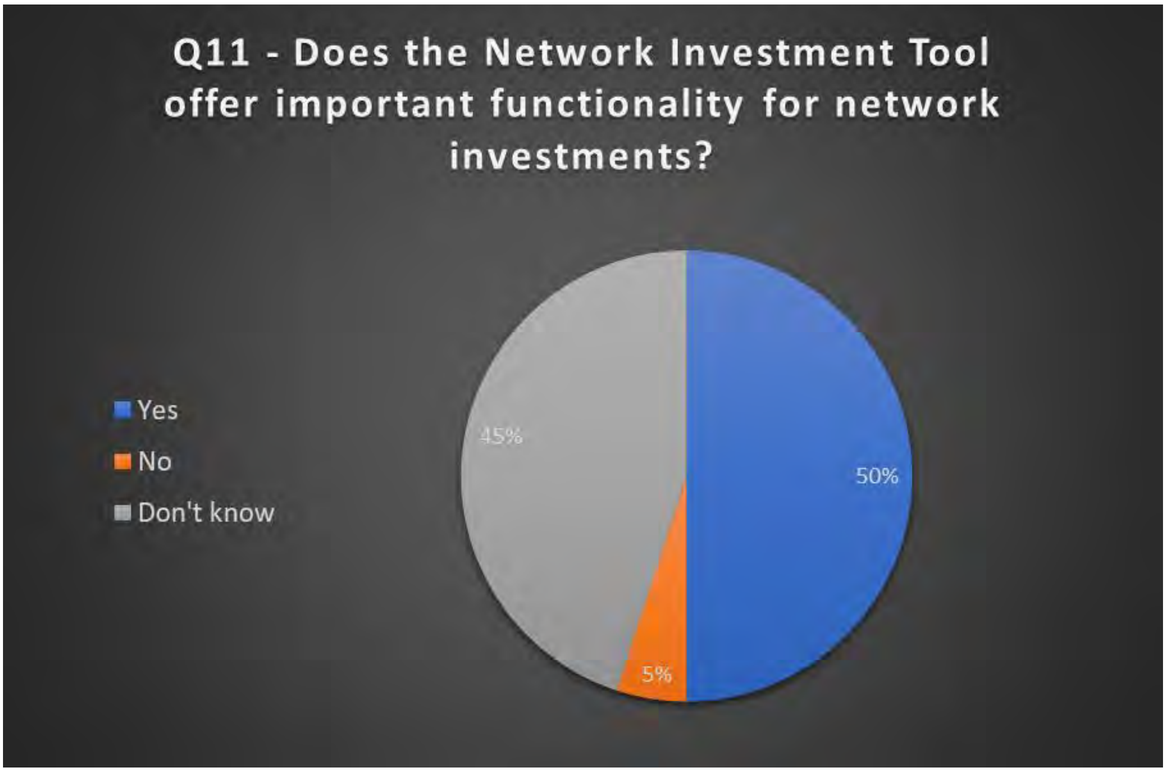


Figure 9 Does the Network Investment Tool offer important functionality for network investments?

Question 12 looks to focus more on DNO use of the NIT and whether such tools should be used. Less people answered this question likely for similar reasons to the 'don't know responses in question 11. Of those who did answer nearly three quarters thought the NIT's functionality was something DNO's should be using in future. Given the large amount of uncertainty that the project team was picking up around the NIT even after the day's events, question 13 asked: would you like to learn more about the NIT to which 80% responded yes. As a result, SSEN organised a series of sessions at the ENA and displayed the offer of DNO roadshows at the closedown event (as well as in numerous follow-up communications) to give a more detailed training session on the tool.

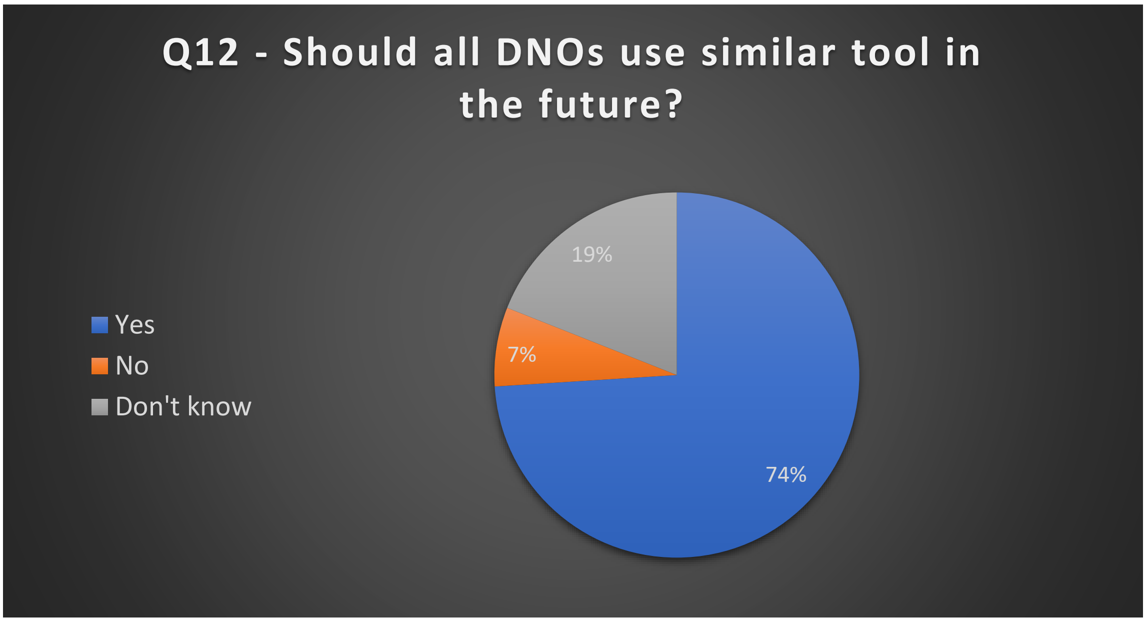


Figure 10 Should all DNOs use similar tool in the future?

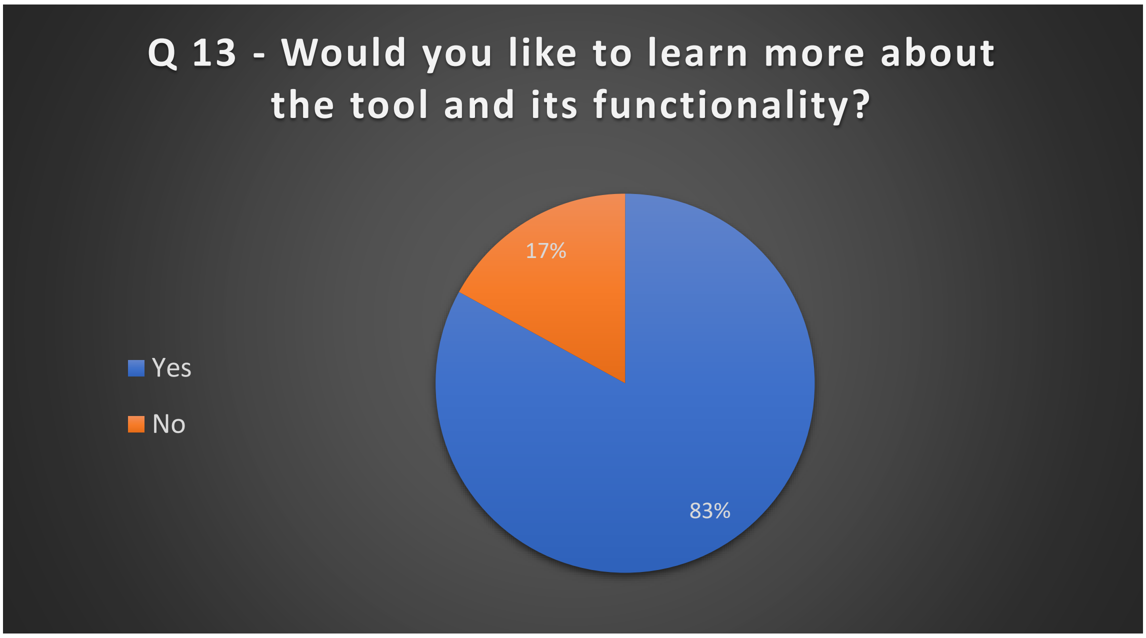


Figure 1 Would you like to learn more about the tool and its functionality?

Event Feedback

Question 14 looked to explore the value participants were taking away from the SAVE closedown event by asking: *"can your organisation implement any of the learnings from the SAVE project?"* To which the overwhelming majority noted they could (88%).

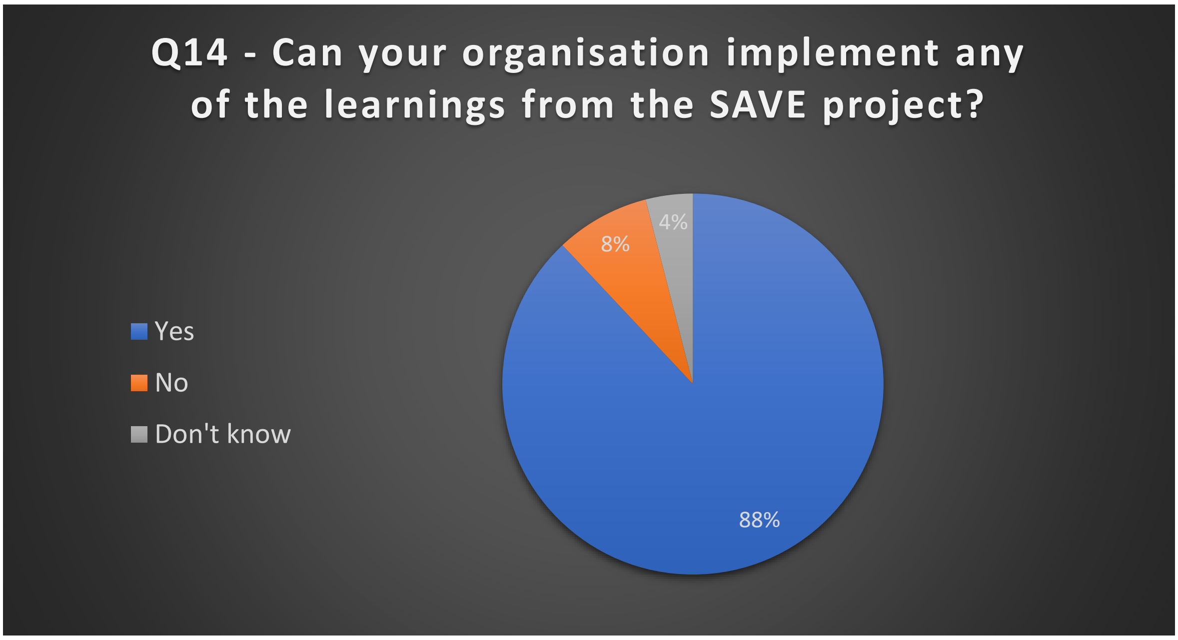


Figure 22 Can your organisation implement any of the learnings from the SAVE project?

Question 15 looked more specifically about how people rated the event as a whole on a scale of 1-5; 1 being very poor, 5 very excellent. On average the event was rated 4.2/5 by participants, with no one scoring the event less than satisfactory (3). In order to ensure that in future SSEN could improve its events or understand areas of the project that the team might look to explore further Q 16 (table 3) asked how people would improve the day's events. Largely comments reflected some background noise in the venue and a requirement for larger (or less) writing on slides to ensure readability.

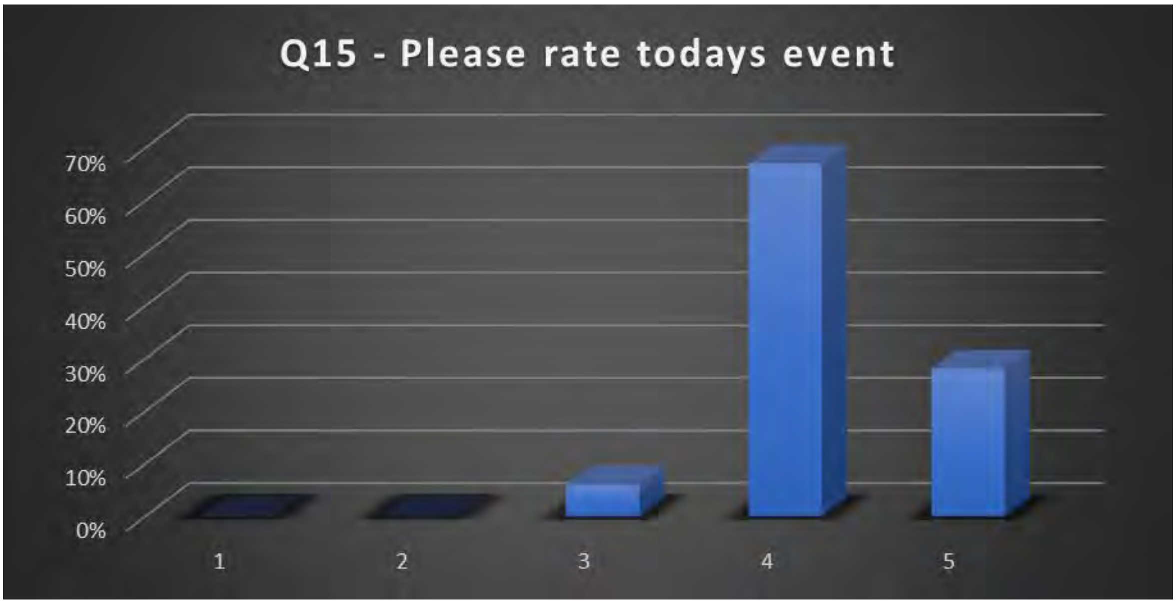


Figure 33 Please rate today's event

Table 3 How would you improve today's event?

Q16 - How would you improve today's event?	
Less noisy venue. Agenda sent more than 1 day ahead.	The noise from the cafeteria was difficult
Larger minimum font size on the slides so that they are readable (suggested 18 point) Roaming microphone for audience when asking questions	Nothing. Hope slides will be available. Pehaps starting slightly later to allow for travel.
Insist on ofgem attending and sitting on the panel. Other than that excellent work.	Bigger screens or bigger writing on the slides!
Venue was too loud! Especially in the small room.	Good

Appendix 9.7- SAVE Houses of Parliament Closedown Slides

SAVE project

June 2019

Scottish & Southern Electricity Networks

The future of energy

The Energy Trilemma
- Affordable
- Reliable
- Sustainable

Carbon Targets
- Distributed Generation
- Electrification of Transport
- Electrification of Heat

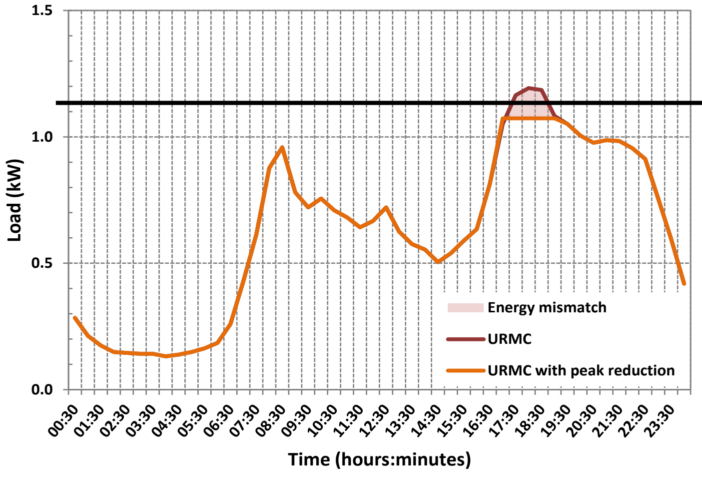
Economic Stimulus
- Sustainable Growth
- Industrial Strategy
- Entrepreneurship

Political principles
- Democratization of energy
- Community Energy
- Market liberalization?

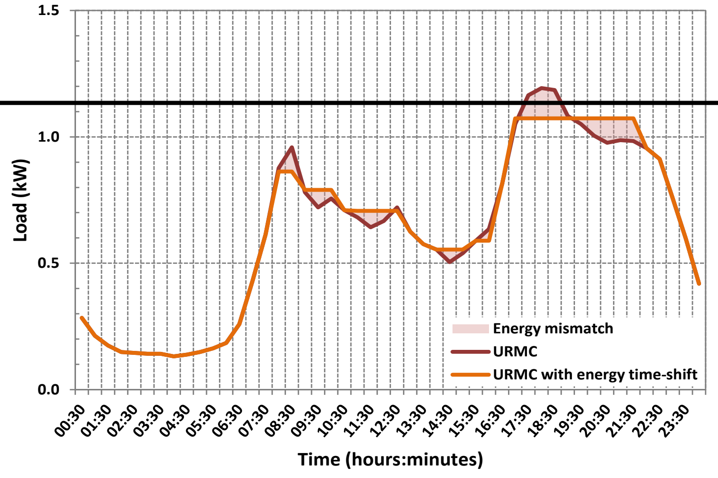
Technical advances
- Digitization
- Energy Storage and flexibility
- Smart Metering

Scottish & Southern Electricity Networks

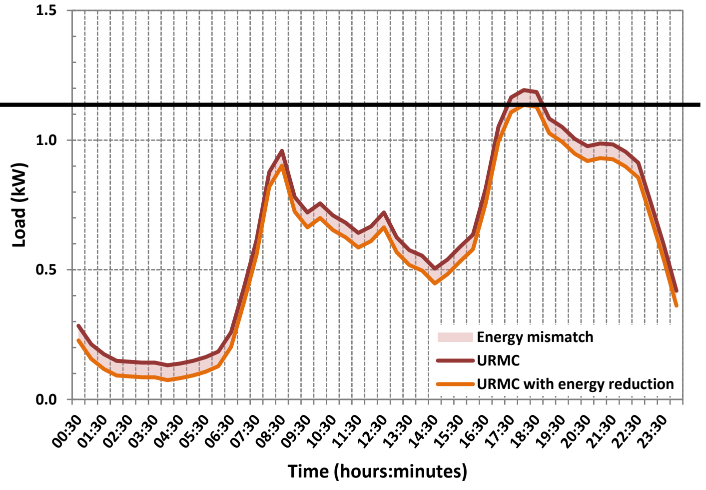
The Challenge



(a) Peak reduction



(b) Electricity time-shifting



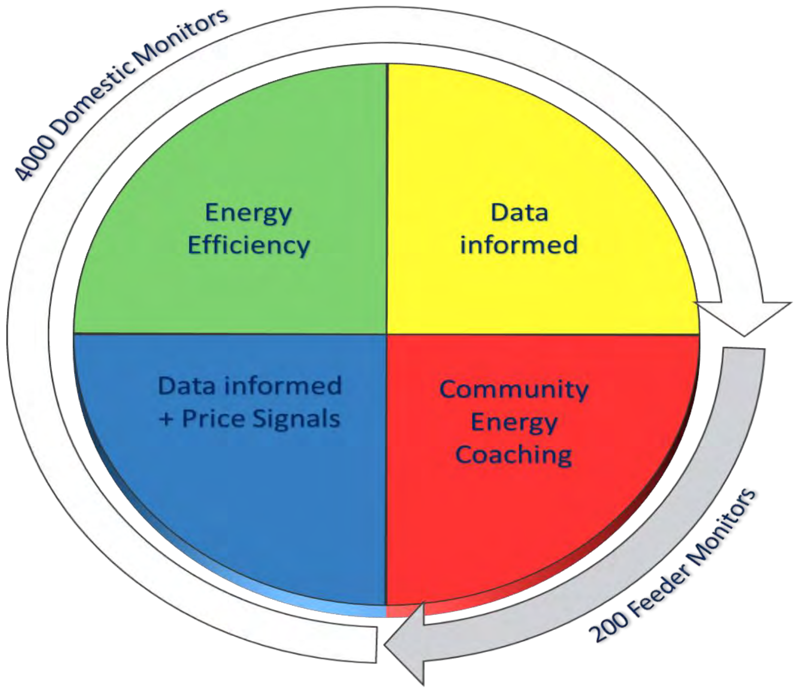
(c) Electricity reduction

SAVE Project

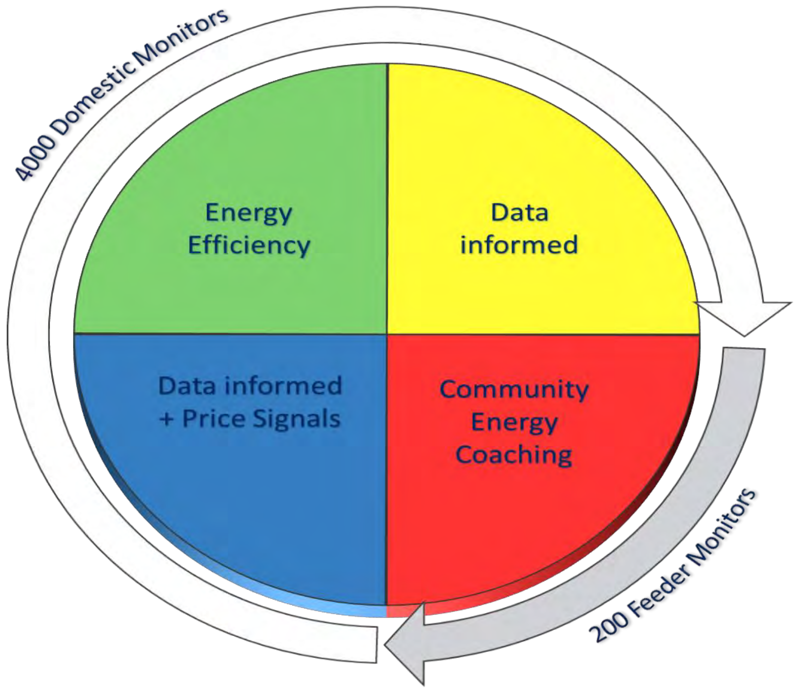
- January 2014-June 2019
- £10 million Ofgem funding
- 8000 domestic Solent region customers
- Largest collection of field data in UK
- Domestic DSR and Customer Engagement
- Network Investment Tool

Scottish & Southern Electricity Networks

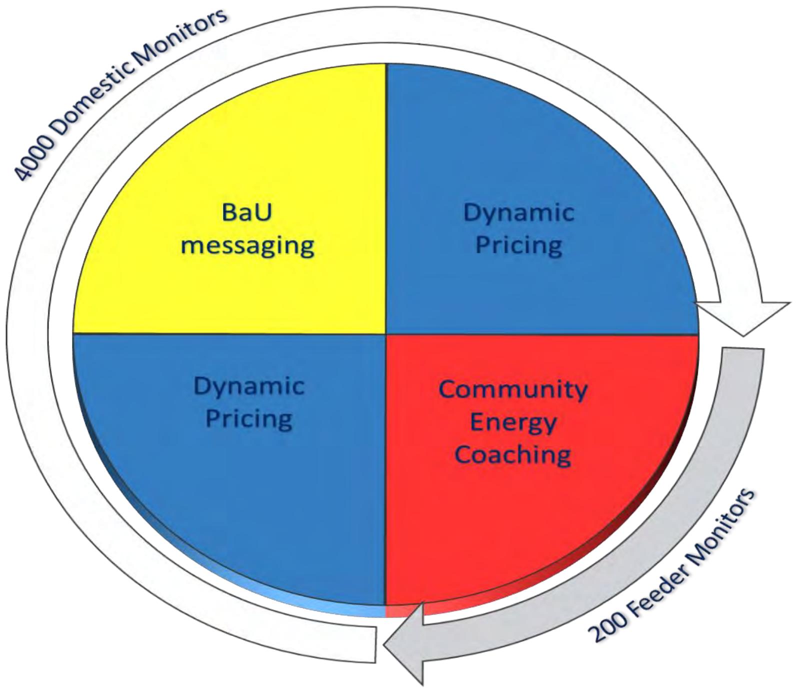
Methodology



TP1: Jan – Mar 17



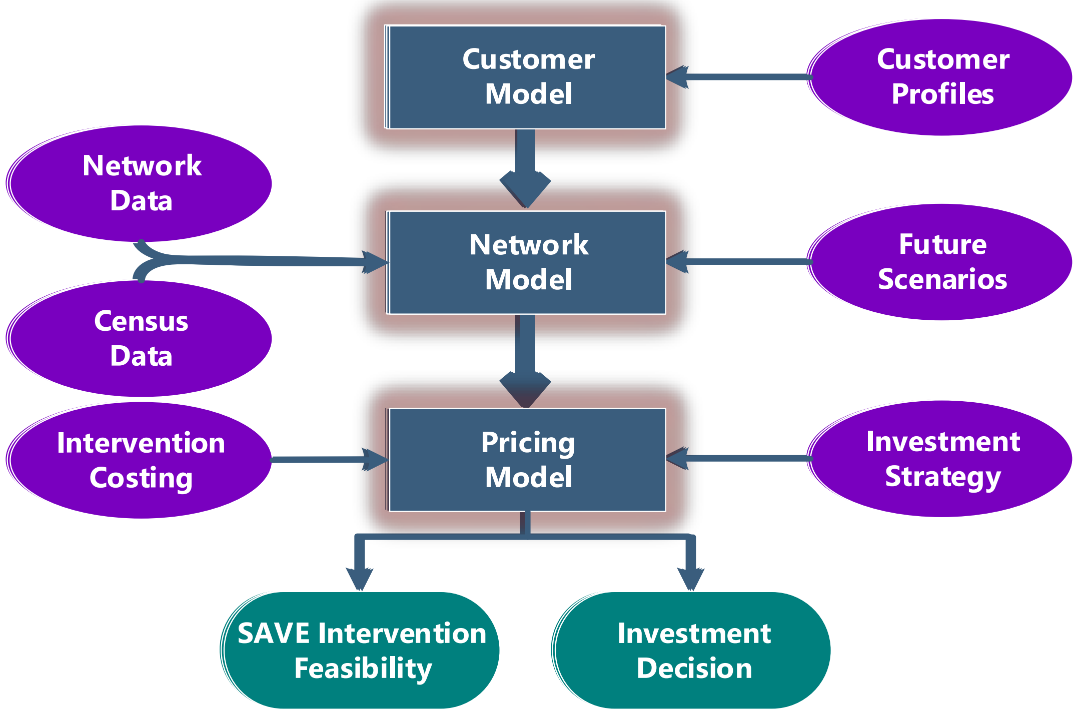
TP2: Oct 17 – Mar 18

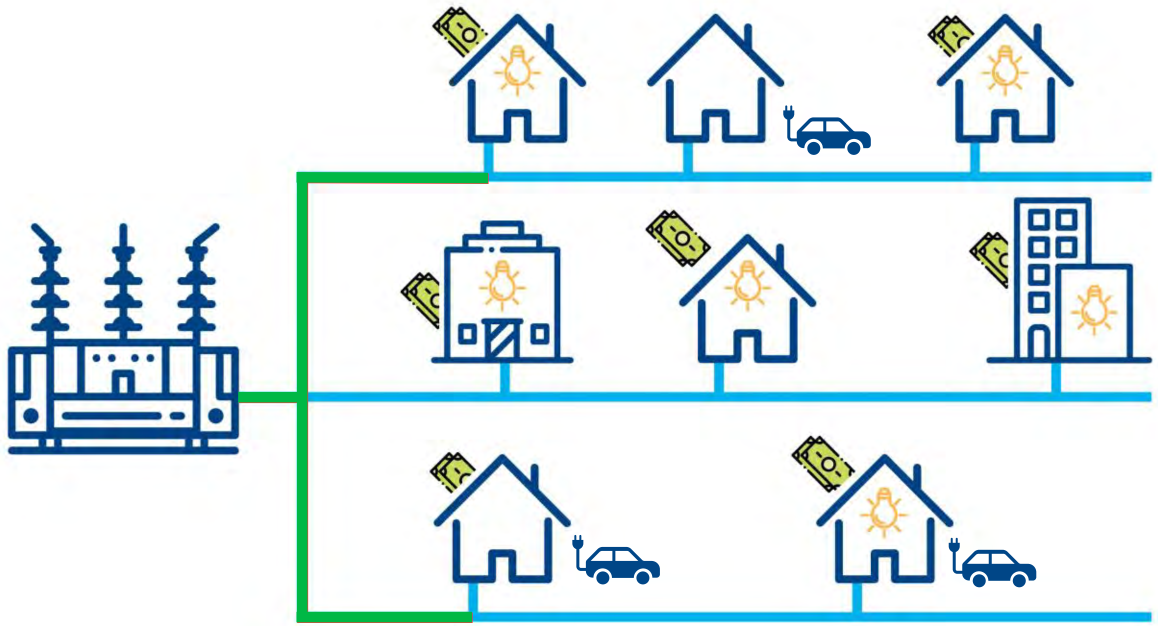


TP3: Oct 18 – Dec 18

Scottish & Southern Electricity Networks

Network Investment Tool





Policy will effect EE, EV and LCT uptake and hence forecasting planning forecasts

TRIAL DESIGN

- Opt-out approach (in-person visits door-to-door)
- Installed by project staff
- Up to 10 bulbs per household available
- Free of charge

HOUSEHOLD UPTAKE 76%

7 AVERAGE NUMBER OF BULBS REPLACED

AVERAGE ANNUAL SAVING PER HOUSEHOLD: 90 kWh

ANNUAL EFFECT SIZE ACROSS VARIOUS METRICS

Household	SAVE project	SSEN customers	UK households
£15.82	37 tonnes CO_2	28,000 cars	1 nuclear power station

- Cost of national LED rollout £1 billion max
- New nuclear plant £5 billion

VULNERABLE CUSTOMERS

TREATMENT EFFECT 5% GREATER FOR VULNERABLE CUSTOMERS THAN FOR THE AVERAGE CUSTOMER

CONCLUSION: if deployed in adequate quantities, and offered free and installed, LED bulbs can effectively reduce peak network load, save customers money on bills and reduce carbon emissions.

SAVE

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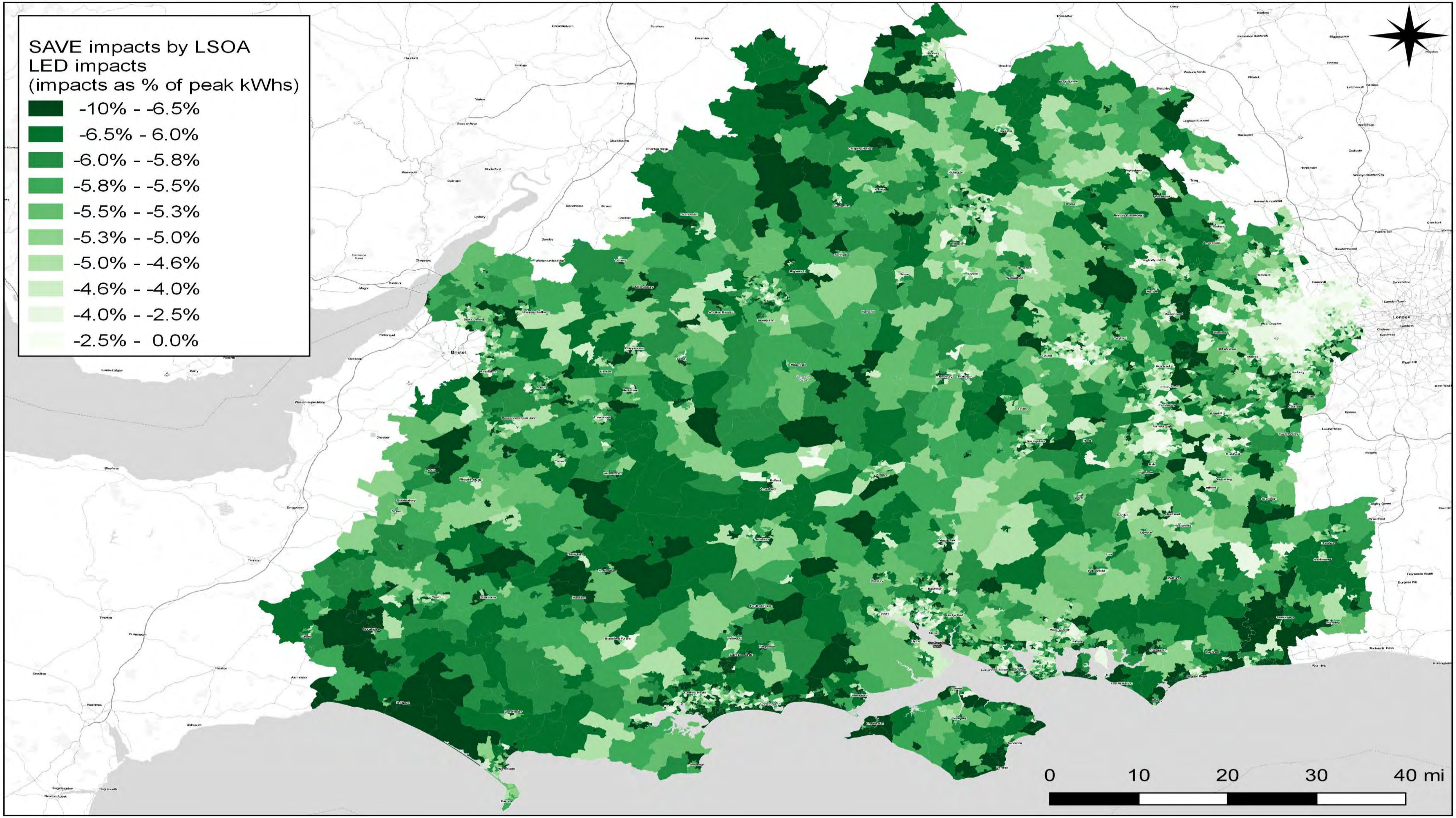
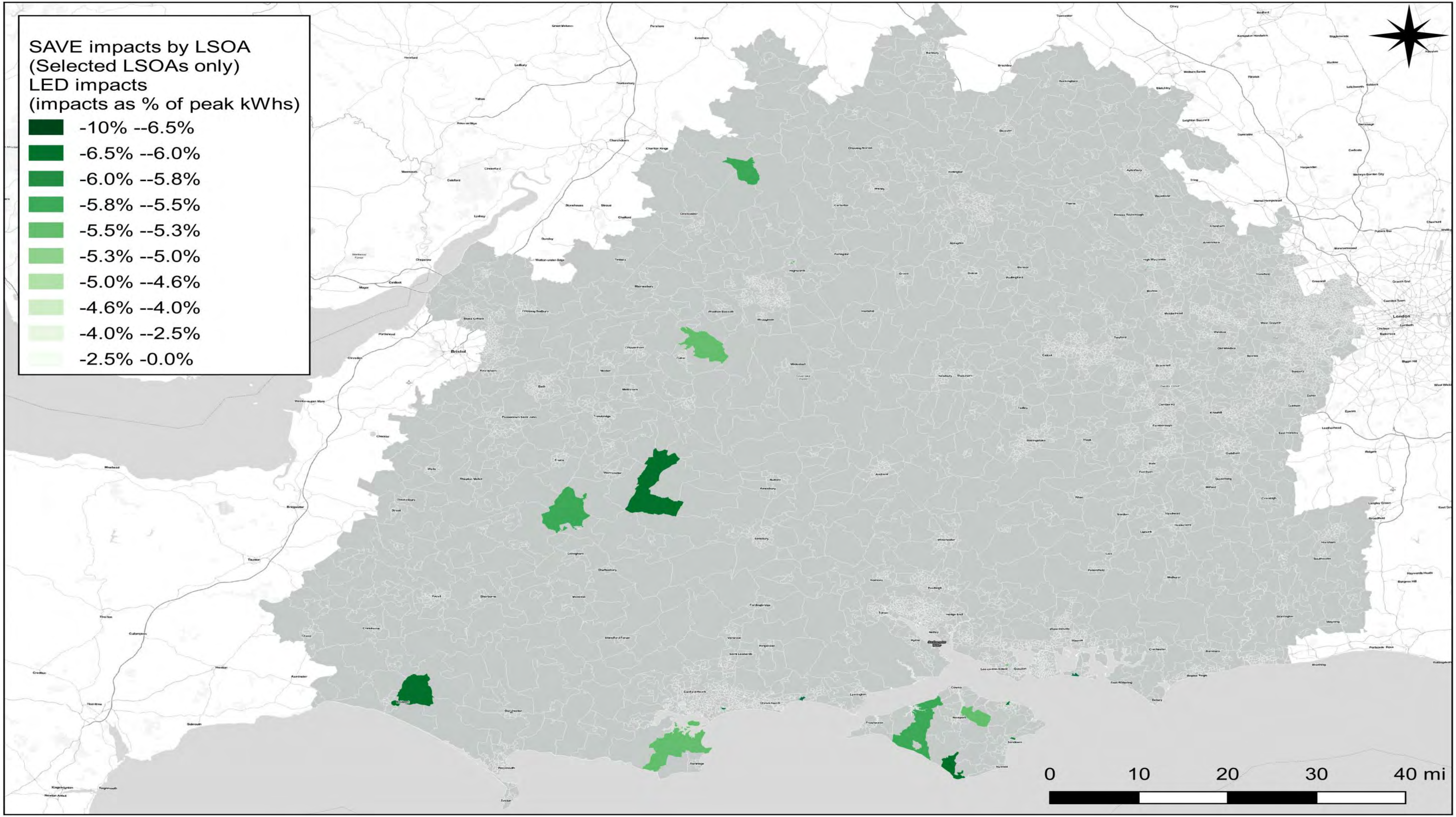
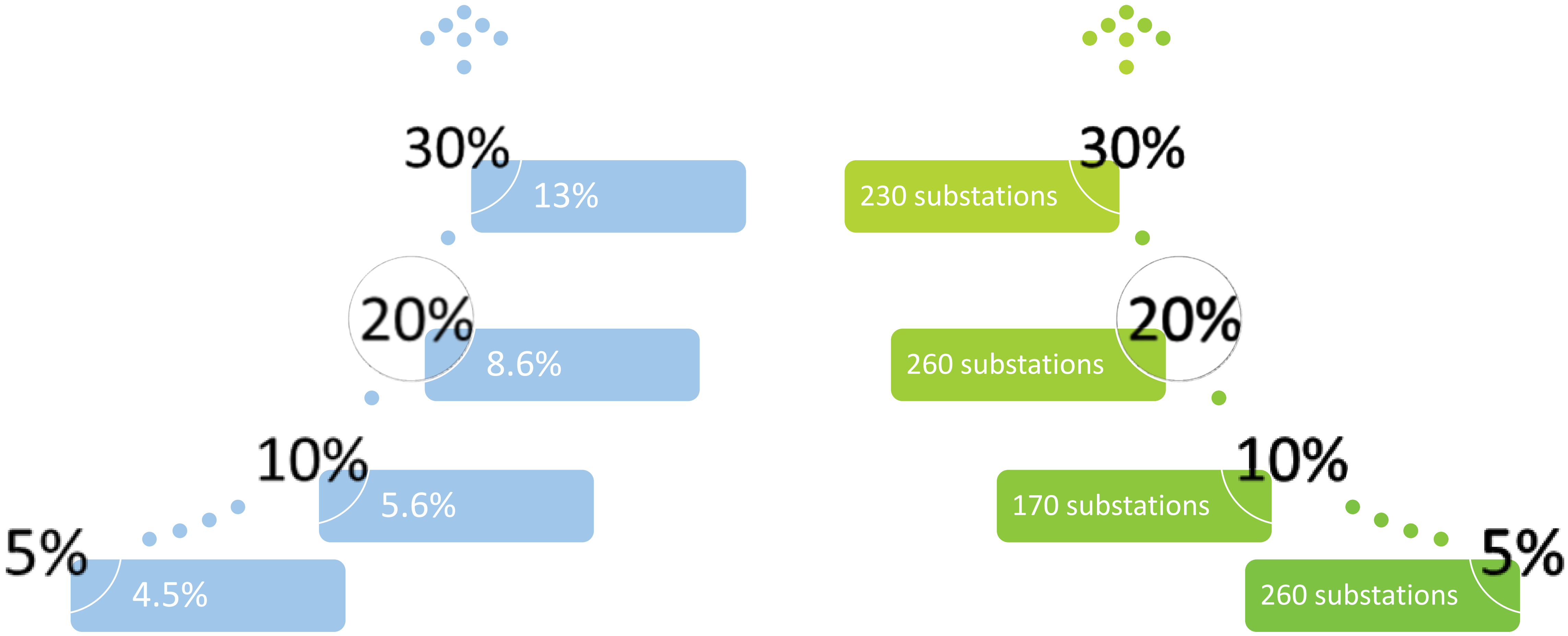


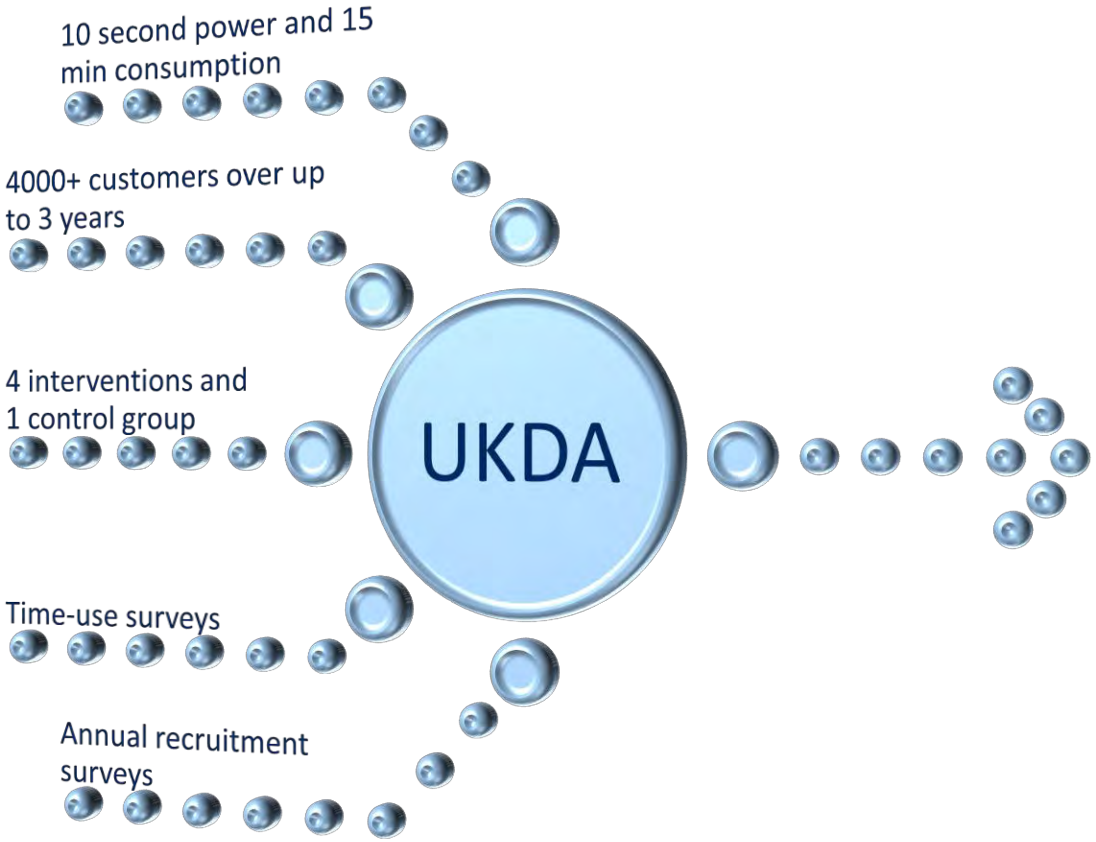
SAVE impacts by LSOA
LED impacts
(impacts as % of peak kWhs)
-10% - -6.5%
-6.5% - 6.0%
-6.0% - -5.8%
-5.8% - -5.5%
-5.5% - -5.3%
-5.3% - -5.0%
-5.0% - -4.6%
-4.6% - -4.0%
-4.0% - -2.5%
-2.5% - 0.0%
Bristol
London
0
10
20
30
40 mi

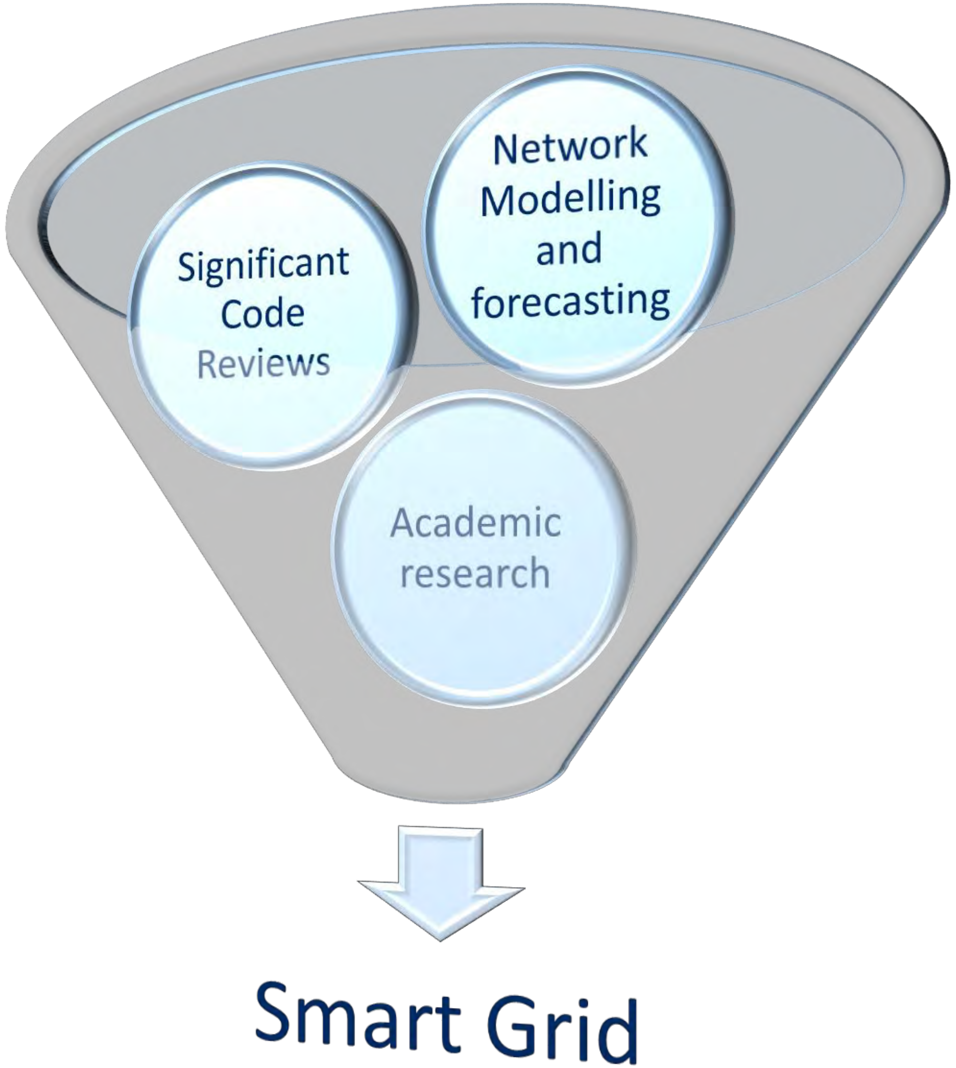

SAVE impacts by LSOA
(Selected LSOAs only)
LED impacts
(impacts as % of peak kWhs)
-10% --6.5%
-6.5% --6.0%
-6.0% --5.8%
-5.8% --5.5%
-5.5% --5.3%
-5.3% --5.0%
-5.0% --4.6%
-4.6% --4.0%
-4.0% --2.5%
-2.5% -0.0%
0
10
20
30
40 mi

SAVE Methods and Future Networks



SAVE dataset





Appendix 10- UKPN Peer Review Letter

Charlie Edwards

SAVE Project Manager

Scottish & Southern Electricity Networks

No.1 Forbury Place, 43 Forbury Road

Reading

RG1 3JH

Dear Charlie,

Solent Achieving Value from Efficiency (SAVE) Close- Down Report – DNO Peer Review

Further to your request for UK Power Networks to review and comment on the Close Down Report produced in respect of Scottish & Southern Electricity Networks SAVE, LCN funded project, I can confirm that we have undertaken this review and consider that the objectives and deliverables as agreed in the Project Direction have been satisfied by Scottish & Southern Electricity Networks.

In addition, subject to the requirements of the LCN funding governance, we can confirm that we consider that the Close Down report as reviewed by UK Power Networks is clear and understandable and contains sufficient detail and information to enable a DNO to make use of the learning generated to implement their own network solution and test similar interventions with domestic customers.

Should you wish to discuss anything further please do not hesitate to contact me,

Yours sincerely,

Angeliki Koulouri

Innovation Project Lead UKPN