Customer-Led Network Revolution

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Progress Report 6

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LCN Fund Low Carbon Networks

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Customer-Led Network Revolution

Contents

1. Executive summary

1.1 The Customer-Led Network Revolution (CLNR) project is assessing the potential for new network technology and flexible customer response to facilitate speedier and more economical take-up by customers of low-carbon technologies and the connection to the distribution network of increasing amounts of low carbon or renewable energy generation. This sixth formal progress report sets out the progress on delivering the learning outcomes relating to understanding existing and future load, customer flexibility, network flexibility, the optimum mix of solutions and the most effective delivery routes to implement those solutions.

1.2 In the September 2010 bid, we set out what we would deliver in each learning outcome and the method to be followed. As is typical of such projects, not all the learning has taken the form originally envisaged. But the method is unchanged and the progress to date suggests that the value of the learning will be at least as good as that in the bid and quite likely better. In particular, the network models, the customer trial data and the research into customers' energy practices are already contributing to a rich socio-technical dataset that arguably exceeds the original expectations.

1.3 Over the course of the project there have been a number of material changes in external circumstances which mean that additional time is needed to deliver the learning outcomes. These circumstances are the slower than anticipated uptake in heat pumps and electric vehicles, solar photovoltaic (PV) 'rent-a-roof' providers not agreeing to the monitoring, and the difficulties experienced in procuring innovative technologies. In all respects, we have found alternative routes to deliver the learning but we are now forecasting to complete in December 2014, one year later than originally planned. Despite the one-year time extension, we expect to complete the project within the original £31m budget. We have submitted a formal change request that has undergone consultation with the other distribution network operators and is now being considered by Ofgem.

1.4 Notable achievements in the reporting period include:

- Installation of the equipment for customer trials has been largely completed (except for a small number of sites)
- 151 smart washing machines installed and the smart functionality piloted with customers
- I&C customers signed up for total of 7MW demand side response for the 2nd round of large-scale DSR trials
- 544 residential trial participants completed the 2nd customer feedback survey
- 230 face-to-face interviews completed with residential and SME customers
- All six electrical energy storage systems (EES) commissioned
- 47 operational engineers trained and authorised to deliver the trials and/or provide specialist standby cover and 29 control staff trained
- Commissioning of the end to end active network management system for two network trial locations: the heat pump cluster network and the PV cluster
- Over 50 external knowledge sharing activities and events, including influential industry bodies such as the Smart Grid Forum workstream 6, and prestigious international conferences such as CIRED and IEEE PES ISGT

1.5 The recruitment and installation process for the customer trials is complete for all but a handful of installations associated with power quality monitoring and we are pleased by the high retention rates. With the range of recruitment and installation issues that we have had to deal with, the trials are staggered in their start and finish times. Thus we have obtained customer agreement to extend some trials while we have started the exit and decommissioning process for the Small Medium Enterprise (SME) trials. The analysis of the data collected has yielded a substantial, rich and varied social science analysis and a large number of academic publications.

1.6 The vast majority of network equipment has been commissioned, through a series of large and complex tasks involving a wide range of personnel and skill sets for a significant number of different and novel pieces of equipment. There has been a huge effort ensuring that the trials programme is optimised, conducting the autonomous field trials, and for preparing for the collaborative field trials. During the commissioning process, one of the two inverters for the largest Electrical Energy Storage (EES) unit failed. Damage was limited to the inverter unit, there has been no impact on the battery cells and no injuries were sustained. A full assessment of the root cause of the failure is being made prior to repair and re-energisation that is expected in quarter one 2014.

1.7 The development of the Grand Unified Scheme (GUS) active network management system has continued during the period and is a highly complex part of the project. We have continued to systematically work through testing and rollout of its various elements including the data warehouse, interfaces between central and remote devices, and interfaces with the network management system. A significant milestone was achieved with the commissioning of the end to end system for the PV cluster network and for the heat pump cluster network. Whilst the GUS development is taking longer than planned, with completion now forecast for December 2013 as opposed to June 2013, we are managing the impact on the network trials through continued use of pre-trial simulation and emulation and by adopting a phased approach to commissioning the control system and start to the trials.

1.8 We have made significant progress in the development of the Network Planning and Design Decision Support (NPADDS) tool. Core design functions have been finalised, and demonstrations have been given to representatives of all DNOs. We have clarified our approach for delivering the other key outputs needed to enable the solutions trialled by CLNR to be adopted as business as usual: operational procedures, training materials, policy guidance and equipment specifications.

1.9 With the installation of both customer and network equipment complete, good rates of customer retention, and our increasing confidence in the network equipment and its integration into the GUS control system, the risks with the highest current risk rating are:

Risk	Current risk assessment	Impact	Mitigating actions	Contingency plan
Installation risk: 1. Network equipment may not operate as specified.	Impact: medium Probability: low Rating: amber Owner: Northern Powergrid	Ability to conduct trials with network equipment	Failure investigations and corrective action	Where possible, use modelling instead of trialling

Installation risk: 25. The GUS central control system may not function as required.	Impact: medium Probability: low Rating: amber Owner: Northern Powergrid	It may not be possible to conduct the network trials under the control of GUS.	Use testing and commissioning to ensure all required functionality is included and working.	Run the autonomous trials and as many of the collaborative trials as is possible using workarounds, dependent upon the extent of the problem. Using the results of the autonomous trials, model the predicted results of the collaborative trials.
Other risk: 48. Loss of academic personnel	Impact: high Probability: negligible Rating: amber Owner: Durham University	Loss of key knowledge and skills will prevent or delay the work of the project, or adversely affect the quality of the learning outcomes delivered.	Make arrangements which allow contracts to be extended, independent of the outcome of the change request process.	Replacement staff to be recruited. This would limit but not entirely mitigate the impact.

1.10 In October 2013 we published interim social science findings (6.2) which identify the household practices which are of most direct interest in terms of their contribution to overall load and their potential flexibility. We also found that smart meters are viewed positively, but that customer attitudes towards heat pumps are less positive and more complex. We have seen that households with PV generation have adapted their routines to make use of the available generation and find in-home displays a useful tool to assist in this. Regarding SMEs, we conclude there is no 'one size fits all' approach to realising flexibility in electricity management, but that realising potential flexibility depends upon interventions tailored to specific needs.

1.11 We have demonstrated how our VEEEG[1] modelling methodology systematically augments and expands the results from field the trials (6.19), and how Real-Time Thermal Rating (RTTR) and EES can support customers under faulted network conditions (6.20a, 6.20ab). We have proposed a new coordinated voltage and powerflow control method (6.20c), and presented how EES could be integrated into this (6.21). Our results from the trial of HV regulators on the rural network have delivered learning on how and to what extent the allowable number of connections for heat pumps, EV and PV connections can be increased (6.22).

1.12 We have created a peak winter loading case study of domestic EV charging, drawing on data from both the CLNR trials and the SwitchEV project (6.23). One conclusion is that the rural network is likely to be more vulnerable to EV growth with power flow being the limiting factor in both networks. The urban network appeared more robust to EV growth than previous studies might have suggested.

1.13 We disseminate learning externally via the CLNR website, e-mails, the CLNR newsletter, PR and media coverage, social media, speaking engagements and participation in industry forums such as the Smart Grid Forum. A number of peer reviewed academic papers have also been published.

1.14 Our approach to learning capture includes a review and write-up on completion of key stages of the project. With field work, we found that having an additional, non operation person on site enables more effective and accurate information capture. Dissemination of learning, both externally and within Northern Powergrid is underpinned by two main principles: communicating in a way appropriate to the target audience and maximising reach by using multiple channels.

[1] VEEEG – Validation, Extension, Extrapolation, Enhancement, Generalization

2. Project manager's report

2.1 With the network and customer equipment in place and operational, our concentration is focussed on running the trials and analysing the data, qualitative and quantitative, and the development of the tools need to integrate the solutions into business as usual.

2.2 In this reporting period, the academic engineering team has moved from Durham University to Newcastle University, following the move of our principal academic Professor Phil Taylor. The academic personnel working on the social science and demand profiles have remained at Durham University.

Learning outcome 1 - existing and future load & learning outcome 2 - customer flexibility

Completing the recruitment and installation stage

2.3 In the previous progress report, we reported that recruitment to the customer trials was substantially complete. The remaining installations that we have completed this period are the installation of the monitoring equipment for the general load monitoring trial 2a which includes electric heating of hot water and storage heating, and of the smart washing machines (10a and 11a) and associated communications equipment, bringing the total of smart washing machine installations to 151. We have also increased the number of installations with power quality monitoring from 2 to 17. By the end of 2013, we expect to add a further 11 power quality monitors, 6 at PV premises and 5 at EV premises, which will provide valuable information on power quality for these low-carbon technologies. The table in Appendix 4 details the number of participants in each test cell.

Customer support

2.4 We provide first line technology support to trial participants by telephone. Many of these are concerned with re-establishing communications with the monitoring equipment after the communications have been lost, usually due to equipment being unplugged or switched off or broadband issues. With this telephone support around 50 customers per week are able to successfully reconnect their monitoring equipment. Where problems cannot be resolved over the phone, we arrange visits to the customers' premises, and during the period this has averaged 8 per week. Approximately a third of these service visits involve matters which can be resolved quite simply and these visits are predominantly to social housing and elderly customers on the heat-pump and electric hot water trials. A notable success has been the PV auto balancing test cell, for which we have received no customers enquires.

Customer engagement and retention

2.5 Retention rates remain high with an overall drop-out rate of 5% across all the residential and SME trials. Drop-out is due largely to change of tenancy or change of supplier or, to a lesser extent, the customer not agreeing to the trial extension (see 2.7). Despite the fact that British Gas has increased tariffs twice during the trial, the drop-out rate for the time-of-use (TOU) trials is just 10% over an 18 month period since April 2012, including customers who did not agree to an extension.

2.6 We had intended to send all residential trial participants personalised home energy reports, but the data validation and processing has proved to be significantly more complex than anticipated. In the next reporting period we will start to send these reports to the residential TOU trial participants.

Trial duration and de-commissioning

2.7 The monitoring period for the majority of residential customers was due to end during 2013. We have written to these customers to seek their agreement to an extension to March 2014. This is to compensate for delays to the start of the monitoring period. Only 38 customers opted not to accept this extension.

2.8 We have commenced decommissioning for the customers not willing to extend the trial and for residential customers where there has been a change of tenancy or change of supplier, with a total of 76 de-commissioned. We have started the process of trial exits and de-commissioning for SME trial participants, with 41 de-commissioned so far. The full decommissioning programme for all trial participants will start in April 2014.

2.9 During this reporting period we identified that restricted hours and TOU tariffs might not be Retail Market Review (RMR) compliant in two respects, firstly the use of compensation payments for trial participants and secondly whether the trial tariffs counted towards the limit on the number of core tariffs that a supplier can offer. British Gas applied for a derogation which would allow these tariffs to remain in use up to the end of quarter one 2014 i.e. after RMR regulations come in to force. The Authority determined that derogation was not required since the compensation payments were acceptable under RMR and since the tariffs are closed to new entrants, which means that they do not count towards the tariff cap. Ofgem did however request several changes to customer trial terms & conditions in relation to their terms of supply, including the pro-rating of extension vouchers should customers opt to leave the trial prior to the March 2014 extension. British Gas will be writing to affected customers to advise them of these changes.

Large-scale demand side response

2.10 During the reporting period we have signed an agreement with the commercial aggregator, Flexitricity, for five Industrial and Commercial (I&C) customers to provide a total of 7MW of demand side response (DSR) for the trials. All five customers have signed on to the pricing structure used in the first trials which is based on the short term operating reserve (STOR) methodology and uses an availability and utilisation component.

2.11 Agreement has been reached with Kiwi Power and ESP for the provision of DSR for trials. A number of these new contracts will use a daily price concept together with a floor methodology, which will require the sites to drop consumption below a threshold level.

2.12 This second set of DSR trials for fast reserve (test cell 18) will take place during the next reporting period.

2.13 Discussions are on-going with a merchant generator regarding the provision of voltage support through the utilisation of reactive power (test cell 19). The trials for fast reserve (test cell 19) will take place during the next reporting period.

2.14 These trial participants are not located in the areas where we have installed network monitoring. Paragraph 4.19 explains how we have dealt with this issue.

Equipment

2.15 We are using the MicroWatt polymeter in a number of residential test cells where we needed to collect disaggregated data from the different appliances within the premises, or as an alternative to a full secondary meter where installation would be unfeasible. We have found that there was a faulty batch of the polymeter and that 71 of our installations were affected. The fix is to replace the motherboard and we have already done this in over half the affected installations, the remainder will be replaced in the next reporting period. This has resulted in delay rather than loss of data since the data is backed up on the on-board SD card and we have been able to recover this in the majority of cases.

2.16 We will be using a smart washing machine as the appliance to provide load reduction from general load domestic customers, either via a restricted hours tariff (test cell 10a) or direct control (test cell 11a). We now have 151 installed, 54 on restricted hours and 97 on direct control and the customers have had some time to gain experience of the smart appliance in standard (non-smart) mode.

2.17 We have successfully piloted the remote upgrade of the smart appliances for restricted hours and have completed the firmware updates of the restricted hours functionality. We plan to roll out the pilot testing and functionality updates for the direct control customers in January 2014. With this experience, we have developed user guide and covering letter for participants in the restricted hours trial, and this has been issued to customers and the 'intervention' part of this trial is now active i.e. customers are experiencing the appliance in smart mode. For the direct control trials, we have finished the lab test and will complete the pilot testing, IHD messaging and functionality updates in January 2014 to commence the trials during quarter one, 2014.

2.18 We have found that in about one third of the smart appliance installations, the distance between the gateway and appliance causes problems with communications. We reported previously that we had used repeater plugs to solve this problem but that we were experiencing compatibility problems between the repeater plug, the smart appliances and the gateway. Since then we have found the cause of this is differences between the appliance and gateway in the way they handle fragmented messages. This problem only occurs with one message type, but it is the key initialisation message without which successful communications cannot be established. We have resolved this by making firmware changes on the gateway and we have successfully completed lab trials and an initial pilot of this. We also have an alternative repeater which we is now being piloted by some customers. There are also alternative, wired, solutions: direct wiring of the gateway or the use of Powerline/Ethernet adapters, the latter has been trialled in the lab and is now being piloted by customers. Altogether, we have four options for communications between the gateway and the appliance, so we are confident that good communications between the gateway and the appliance can be established for all trial participants. Resource is now being put in place to rollout the repeater solutions and to monitor the resilience of the communications.

Qualitative and quantitative trial analysis

2.19 The second residential on-line survey was completed with 544 survey returns . An accompanying interim report is available on the CLNR website. 741 respondents completed the first domestic survey and 544 completed the second; meaning that a total of 1285 survey responses from 1086 respondents across both residential (part 1 and part 2) surveys have now been received. For a subset of approximately 750

participants we now have both a survey and a good record of electricity consumption, which will allow in-depth socio-technical analysis to take place in the next reporting period.

2.20 We have completed over 240 face-to-face research interviews (home visits) with participating domestic and SME business customers; details can be found in the interim report[2]. All face-to-face research interviews with domestic and SME business customers are now completed with the exception of the smart appliance trial participants. We have constructed a database in the commercially-available NVivo 10 qualitative research data management software to hold all of the data collected from the interview programme. The analysis team is now in the process of actively using the database to begin answering our social research questions. Some initial analysis during this reporting period and some initial findings are also given in the second interim social science report and a synopsis is presented in section 6.2 of this report. We will continue to work with the qualitative data in the next reporting period to draw further conclusions surrounding the social aspects of electricity usage.

2.21 134 heat pump trial participants completed an email survey. For others who couldn't be contacted by e-mail a 10-minute telephone survey was designed as an alternative way of capturing their responses. Since the original general residential online survey took about 25 minutes to complete, for practical reasons the telephone survey was a more concise version of this, featuring around 25 questions which asked about the operations of the participant's heat pump and its configuration, and collected participant socio-demographic data e.g. size of household, tenure, age etc.

2.22 We designed and deployed an online survey for EV customers participating in CLNR through Charge Your Car. The 46-question survey was a customised version of the general residential online survey, and gathered socio-demographic information about the respondents as well as information about attitudes to electricity and energy use and, naturally, electric vehicle ownership. To date 82 out of 140 participants have responded to the survey. Analysis of the survey will take place in the next reporting period.

2.23 We produced a report entitled "**Initial Heat Pump Load Profiles from CLNR Low Carbon Technology Trials**", which describes some early findings from heat pump operations and was accompanied by a set of load profiles. This report is still in internal review and is expected to be finalised for release in the next reporting period. Some initial findings from this work are discussed in 6.12.

2.24 In this reporting period we have directed substantial effort towards ensuring that our data management is built on sound foundations, and the effort directed to this means that we have not carried out as much analysis by this stage as we would have liked. In the next reporting period we expect that all the LO1 and LO2 data collected will be validated and under analysis.

2.25 We have planned a final programme of interviews of 15 industrial and commercial load and generation customers, which will provide qualitative evidence to update previous reports on the effect of the April 2010 CDCM tariff reform on I&C customer behaviour. The interviews themselves and the updating of the previous reports will take place in the next reporting period and will conclude the work in this area.

Learning outcome 3 – network flexibility

2.26 The work of learning outcome 3 consists of the network technology, the GUS control system, and the network trials. The commissioning of the network technology and the control system is substantially complete and comprises the items in the following table.

[2] Analysis of the qualitative data relating to EV trial participants will take place in the next reporting period

Equipment		Urban network Rise Carr, Darlington	Rural network Denwick, Northumberland	Heat Pump Cluster Hexham, Northumberland	PV Cluster Maltby, South Yorkshire
Electrical energy storage (EES)	2.5MVA battery at primary substation (EES1)	Rise Carr[3]			
	100kVA battery at distribution substation (EES2)	High Northgate	Wooler Ramsey		
	50kVA battery at distribution substation (EES3)	Harrowgate Hill	Wooler St. Mary		Mortimer Road
Enhanced automatic voltage control (EAVC)	Primary substation transformer with on-load tap changer (EAVC1)	Rise Carr	Denwick		
	Secondary substation transformer with on-load tap changer (EAVC2)	Darlington Melrose	Wooler Bridge		Mortimer Road
	Regulator (EAVC3)		Hepburn Bell AND Glanton		
	Switched capacitor bank (EAVC4)		Hedgeley Moor		
	LV main distributor regulator (EAVC5)			Sidgate Lane	
Real-time thermal rating (RTTR)	Primary substation transformer	Rise Carr[4]	Denwick		
	Secondary substation ground mounted transformer	Darlington Melrose High Northgate	Wooler Bridge Wooler Ramsey	Sidgate Lane)	
	Overhead lines		2 locations at 66kV 4 locations at 20kV		
	Underground cables EHV	Rise Carr			
	Underground cables HV	Rise Carr			
	Underground cables LV	Darlington Melrose			
Grand unified scheme (GUS)		GUS central controller			
		14 GUS remote distribution controllers (RDC)[5]			
		GUS Data Warehouse			
		Demand response system integrated into GUS control			
Monitoring		70 instances of monitoring equipment (of 3 different types) at a range of network locations[6]			
		iHost data warehouse			

[3] An inverter failed during commissioning, see 2.28
[4] The thermal transducer requires a refit, so commissioning will be completed in the next reporting period
[5] 75% of the GUS RDCs have been commissioned. The remainder will be commissioned in the next reporting period
[6] Includes power quality monitoring

Network equipment

2.27 At the bid stage, we identified that one of the key risks to the project was that the network equipment might not operate as specified. Until all the equipment has been proven in the trials, this risk remains although it diminishes as each item of equipment is trialled. This risk, risk 1, is discussed in more detail in section 4.

2.28 Commissioning of the six EES units has been a major activity during the reporting period. This is the first time that EES has been installed deep in a UK distribution network. The large 2.5MVA unit is connected at high voltage on the Rise Carr urban network trial area. During a charging cycle, as part of commissioning, one of the two inverters failed. Damage was limited to the inverter unit and there has been no impact on the battery cells, and no injuries were sustained. A full assessment of the root cause of the failure is being made prior to repair and re-energisation. We expect to commence repairs to the unit in January 2014. The inverter supplier for the large 2.5MVA unit is Dynapower and for the smaller units is ABB. As such, there is unlikely to be any consequential impact to the operation of the smaller units.

Figure 1 - Rise Carr 2.5MVA battery and inverters

Figure 2 - High Northgate 100 kVA battery

Figure 3 - Transformers with on-load tapchangers

2.29 During the period, significant efforts have been made to train and authorise operational engineers to work on our trial equipment, either as part of the trials or to give specialist 24-hour standby cover. This operational training and authorisation has been designed to include and cover the whole scope of the equipment installed plus the diverse range of network locations and to the same standards as apply in business as usual.

2.30 To facilitate this we have written two operational guidance documents and published these within Northern Powergrid's controlled document system:

- OPS/007/001 – Operational guidance and training requirements associated with the trial of secondary transformers equipped with an integral on load tap changer
- OPS/007/002 – Operational guidance and training requirements associated with the trial of battery electrical energy storage systems

and a third is almost complete

- OPS/007/ 003 Operational guidance and training requirements associated with network trials using the Grand Unified Scheme (GUS)

2.31 We have trained control engineers and operationally authorised engineers so that they can deliver the trials, maintain the trials equipment and ensure the quality and uptime of the monitoring systems. The numbers of operational engineers trained is as follows:

Battery Storage (2.5MVA, 100kVA & 50kVA systems) training Distribution on-load tap changer training	47 commissioning and specialist standby engineers
GUS Control System – PowerCC central intelligence training	29 network control engineers
GUS Control System – Remote distributed controller (RDC) on-site training	6 network control engineers

GUS control system

2.32 The GUS control system comprises the central controller, the remote distribution controllers (RDCs) and the interfaces between the central GUS and the RDCs. The RDCs interact with the EES, monitoring, RTTR equipment and EAVC (collectively referred to as 'Enhanced Network Devices' or ENDs). The simplified diagram below illustrates how these components interact, and the relationship between the central and the remote elements.

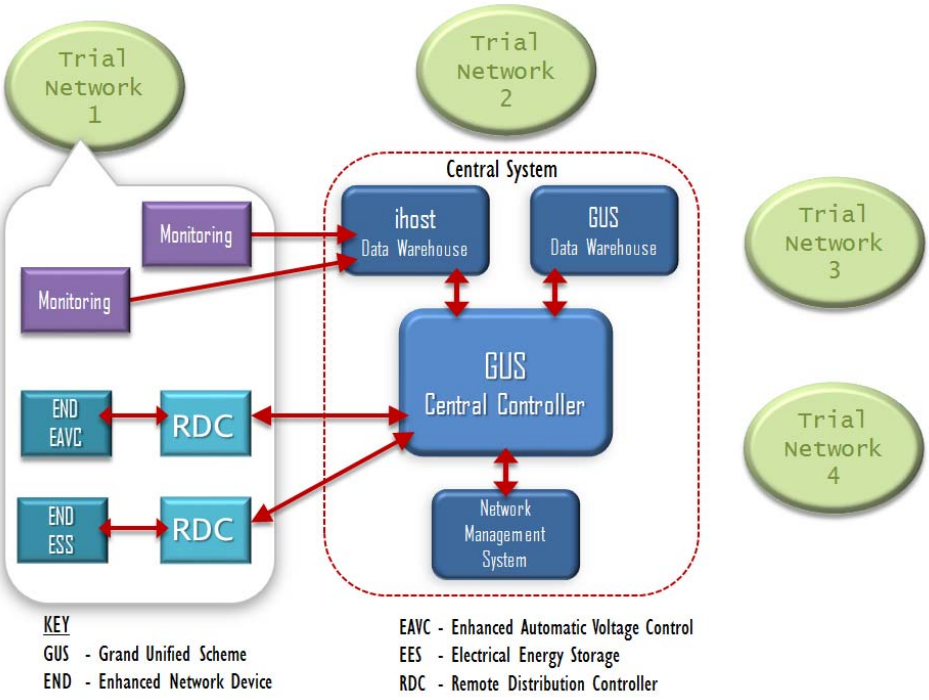

Figure 4 - simplified schematic of GUS and trial networks

2.33 The remote elements are located within the four trial networks and at various other points of interest on the Northern Powergrid network.

2.34 The GUS control system provides the capability to remotely control ENDs, thus managing power flows, and voltage and thermal constraints. It runs alongside the existing network management system which manages safety and network configuration.

2.35 At the bid stage, one of the key risks we identified related to the delivery of a functioning integrated demand response system (risk 2) to provide signalling between the central GUS controller and the parties calling the demand response from the customer. Other active risks relating to the GUS are that the central control system might not function as required (risk 25) and that some items of network equipment may not integrate correctly with the central control system (risk 44). In the reporting period we have made significant progress on the development of these systems and so the overall level of the GUS related risks has reduced. For more information, see section 4.

2.36 We have successfully commissioned the GUS data warehouse, completed the testing of the interfaces between the RDC and all of the ENDs, and configured the transformer RTTR thermal management control software in the RDC.

2.37 We have migrated the OHL RTTR system from an externally hosted server to a dedicated server within Northern Powergrid's corporate IT infrastructure, and integrated it into the GUS system. We have completed the integration of the iHost database of monitoring data into the GUS system i.e. with the RDC and with the central controller.

2.38 We have configured alarms on the storage and EAVC equipment to feedback via existing SCADA systems.

2.39 We have successfully completed factory acceptance testing of the software systems for the GUS central controller and for the RDCs, and end to end bench testing of the complete control system. Alongside this we have tested the interface between the GUS system and the existing network management system, which includes configuring alarm displays and information transfer from the Network Management System (NMS) to GUS.

2.40 We have commissioned the end to end system for the heat pump cluster network and for the PV cluster network. In the next reporting period we will complete the phased site acceptance testing programme to commission the system for the urban and rural networks.

2.41 It is taking longer than planned to complete the design and build of the GUS control system. We expect to complete in December 2013 as opposed to June 2013. The impact on the network trials is being managed through continued use of pre-trial simulation and emulation and a phased commissioning of the control system and start to the trials.

Network trials

2.42 The main objective of the network trials is to evaluate the capabilities of the network interventions and control systems to mitigate voltage and powerflow issues arising from the large scale deployment of LCT load and generation. To enable this, voltage and powerflows are controlled on a live electrical network within more stringent upper and lower voltage and thermal limits so that observations can be made as to how the various pieces of active equipment react in isolation or in tandem with others. This data is being collected and evaluated. The trials are split among 4 network flexibility test cells which enable investigation of specific future scenarios;

- Heat pump cluster at Sidgate Lane substation, Hexham
- PV cluster at Mortimer Road substation, Maltby
- Urban network trials fed off the Rise Carr electrical network, Darlington
- Rural network trials fed off the Denwick electrical network, Wooler

2.43 We have also developed processes to enable the roll out of trials operationally. This takes account of a number of factors; the expected outcomes of the trials (based on pre-trial modelling), technical recommendations, approval from network control, and the requirements for operational staff. For each trial we have developed a detailed trial pack which contains control and operational information about the trial: its objective, the procedures and the equipment settings.

2.44 In this reporting period we have used the VEEEG[7] methodology to develop a 'learning credits system' (see 6.18). With this, we can identify those trials which will deliver the most valuable learning, which enables us to prioritise trials so that we can efficiently schedule the trials and maximise the learning achieved. The CLNR trial methodology is likely to be an output from the project in its own right. This is additional to the bid as it was not originally considered that the trials process would be developed so as to be useful to others in its own right.

2.45 In preparation for the field trials, we have used the latest data from our monitoring systems to complete the pre-trial simulations for the trials that are due early in the schedule. Pre-trial simulation needs to be carried out shortly before the time of the actual trials to maximise the

[7] VEEEG – Validation, Extension, Extrapolation, Enhancement, Generalization

learning from a trial and enable validation of the results. In the next reporting period, we will complete the pre-trial simulations for trials due later in the schedule and we will carry out post-trial analysis.

2.46 We have completed a report titled "**Pre-trial design simulation and analysis for Maltby autonomous voltage control trials**" and a companion briefing note. These documents were primarily developed to enable design of the voltage control trials in terms of equipment settings etc. for inclusion in the trial pack.

2.47 We have completed a report titled "**Initial Trial Analysis - HV Regulator Autonomous and Single + GUS Voltage Control at Denwick**" and a companion briefing note. These documents include sections that enable design of the voltage control trials in terms of equipment settings etc. for inclusion in the trial pack.

Learning outcome 4 – optimum solution

2.48 The objective of learning outcome 4 is to develop the optimum solution to resolve network constraints which would otherwise result from the transition to a low carbon economy. For each form of network constraint and each customer type we will consider the optimum solution. The optimum solution will then be used to update network design guidance and will be built into the tool for network designers, NPADDS.

2.49 We do this by combining the data and analysis outputs from learning outcomes 1, 2 and 3 with desktop modelling, simulation and emulation to identify the best solutions. This approach allows us to model combinations and future scenarios that are not currently feasible or economic to pilot in the field.

2.50 We continue to update and validate models of the trial networks as further data from the network monitoring systems becomes available. The latest initial and pre-trial reports use the up to date customer data analysis from learning outcomes 1 and 2, and from other sources, and further network monitoring data collected from learning outcome 3 to model a wide range of scenarios for future smart grid enabled distribution networks with large quantities of LCT load and generation.

2.51 We have also continued to use this data and the models to predict the outcomes of a wide range of the early network field trials. This simulation work has also enabled us evaluate which trials provide the most learning and therefore to optimise the trial programme.

2.52 In order to bring together the outputs from learning outcomes 1, 2 and 3 we have created the storyboard for an "optimum solutions" paper which outlines a merit order for solutions to network constraints. This will bring together:

- learning from trials within the programme;
- validation from other like projects elsewhere, which is part of the "V" for validation in the VEEEG methodology;
- compare and contrast with unlike solutions from projects elsewhere, and conventional solutions;
- the DNOs' appetite (on behalf of their customers) for risk;
- proofing against an uncertain future;
- upgrade paths.

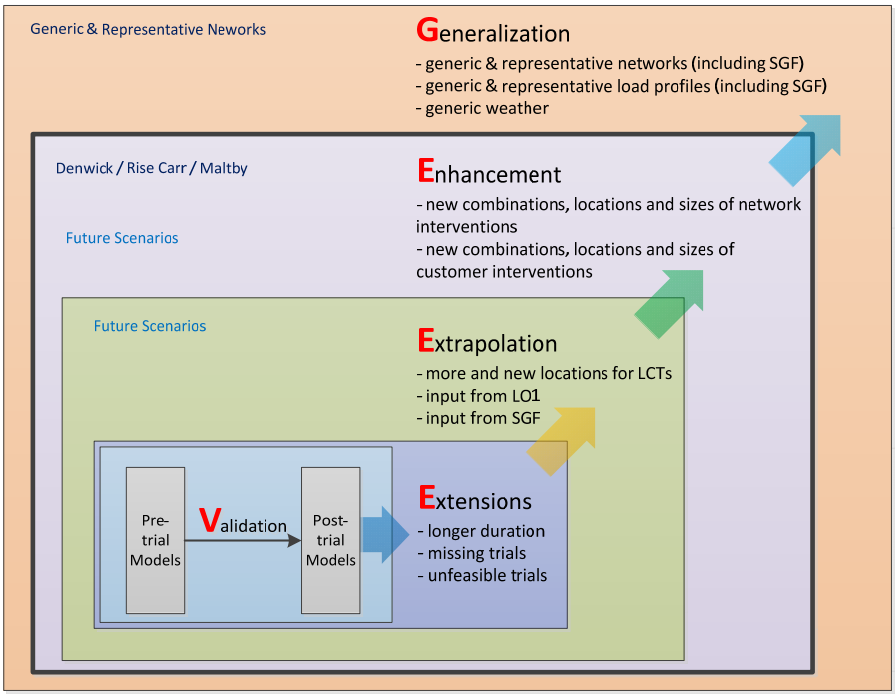

Figure 5 - conceptual representation of the VEEEG methodology

2.53 Detailed analysis of each solution will have been covered in the academic VEEEG work. This optimum solutions paper is part of the mainstream of DNO policy development work, taking that academic learning and placing it firmly in an industrial context. It is also more wide-ranging than the VEEEG analysis, as it must consider non-CLNR solutions in order to be able accurately to create a merit order of solutions. Forging this coherent, wide-ranging view of how to engineer future networks is what CLNR is all about. Individual solutions are merely links on the chain.

2.54 One key purpose of the paper is to refine the requirements for the work to be undertaken in 2014. By better understanding the overall picture, we can inform what the academic VEEEG analysis will deliver; which in turn informs delivery of the data analysis and the network field trials.

2.55 The paper will be a discussion document, looking at opportunities and solutions, and explaining why in practice a DNO might take a certain policy stance. The paper's conclusions will be structured so that they can be lifted almost verbatim and placed into policy documents. Those conclusions will also direct the coding of the NPADDS design tool: as it is self-evident that the design tool should reflect the policy.

2.56 We will publish this paper as part of programme close-down report.

Learning outcome 5 – most effective delivery

2.57 The objective of learning outcome 5 is to provide a framework for the transition of the technologies and interventions trialled in CLNR into Business as Usual (BAU). For DNOs, this includes the provision of prototype design software tools, material for training courses, new operational procedures to define safe working practices for the new technologies, policy guidance documents and recommendations for an updated design standard (ACE49). For the wider industry, this

includes possible new commercial models, policy recommendations as well as an assessment of the value of these solutions to the customer.

Operational procedures

2.58 We have started the process of developing and updating operational procedures, starting with those new procedures needed for the safe running of the first network trials (2.29). In the next reporting period we will continue to work on the operational procedures for Northern Powergrid and to develop a set of generic, rather than system specific, procedures which can form the basis of adoption of the solutions by other DNOs. These operational procedures are essential for the solutions demonstrated by our project to be integrated in BAU by other DNOs, a recurring theme at the 2013 Low Carbon Networks Fund conference.

Network Planning and Design Decision Support tool (NPADDS)

2.59 Significant progress has been made on the prototype NPADDS design tool. Core design functions have been finalised and regular demonstrations and feedback sessions for the tool have been given to a variety of stakeholders within Northern Powergrid, including connections staff, system design and strategic planning. Demonstrations of the system have also been given to representatives of all GB DNOs.

2.60 We have engaged in a second bi-lateral knowledge sharing session with Western Power Distribution's Project Falcon to discuss NPADDS and their prototype simulation software tool, also currently under development, the Scenario Investment Model (SIM).

2.61 The method of data exchange between Northern Powergrid's network datasets and the load flow tools used in NPADDS has been finalised. The Common Information Model (CIM) is used, which is an open-source standard for information exchange for electrical networks. We have built on CIM, adding data classes and relationships, to make it suitable for advanced network studies. This has the potential of allowing greater flexibility for GB DNOs to use network assessment tools without the risk of being single-sourced due to the use of proprietary data formats.

2.62 All the network data for the CLNR trial networks have now been successfully loaded into NPADDS. This allows us to compare an NPADDS network load assessment with the same network modelled using the VEEEG network models.

2.63 The specific NPADDS functions that have been built and demonstrated for the test cell networks are:

- Fast network assessments for high volume connection requests.
- A 'PV Tool' which informs a designer of the maximum amount of PV generation that can be connected to an LV area without a risk of voltage constraints, taking account of domestic and commercial summer load profiles.
- Integration of the Smart Grid Forum Work Stream 3 (SGF WS3) datasets, derived from DECC LCT uptake scenarios. This enables NPADDS to model the likely effects of those scenarios on LV and HV network areas over multiple years.

- Integration of network assessments for HV and LV areas. This allows a designer to view the robustness of the HV network when conducting LV assessments, and vice versa. This has the potential to release significant capacity which is locked into networks through separate HV/LV design practices, common to all GB DNOs.

2.64 Work continues to develop algorithms to model the CLNR solutions in NPADDS. This will be informed by the network trials and our modelling work. Cost benefit assessments, similar to those used in SGF WS3, are in the final stages of development in NPADDS. This will prompt designers to consider smart solutions where they are likely to be cost effective.

Training delivery plans & training material

2.65 A significant number of training courses have been delivered to control and operational staff as part of the wider safety program to ensure that staff are familiarised with the technologies and features in the network trials (see 2.31). We are building on this to develop a specification of the training requirements to integrate the solutions trialled by the project into business as usual, setting out the necessary training modules for each staff role. Training packages are being generated in earnest and we have started scoping the e-learning package which will provide an overarching framework for delivering the training.

Policy guidance documents

2.66 The overall process of developing new policy documents has been to conduct a base-lining exercise of existing policy documents to identify where changes will be required to cover the deployment of smart interventions. The existing policy document clauses, and associated data, were placed in the NPADDS database. From this, a set of 'foundation' documents were created for each of the technologies and interventions (EAVC, RTTR, EES, DSR, GUS) which describe the current document 'coverage'. The new policy statements can now be developed in full cognisance of existing relevant clauses.

2.67 The policy guidance documents that will be developed can broadly be described as design guidance (assessment of load and identifying potential solutions to constraint breaches) and application guidance for the deployment of specific CLNR solutions. The development of application guidance for each of the technologies is progressing, with an emphasis on capturing learning from the installation work. The development of these work packages has informed and shaped the network trials by pushing the team to focus on the outputs that are required.

Impacts on power quality

2.68 Initial data from a range of network power quality monitors, specifically providing signatures from PV, heat pumps and µCHP installations. Data from an EV charger has been analysed and we continue to explore ways of obtaining more data such as installing network monitoring equipment onto EV clusters installed through My Electric Avenue.

2.69 Network modelling activity is progressing well, which will allow the team to scale up the power quality signatures to understand the effect of greater concentrations of LCTs on different network types.

LV Network Design

2.70 During this reporting period we have established the approach which we will use to develop recommendations for the update of the ACE49/105, the LV network design standard. This approach, which we will apply in the next reporting period, includes the following main steps

- Investigating the benefit of constructing separate load profiles for different socio-economic groups based on Test Cell 1 data outputs;
- Estimating P and Q values for general domestic customers based on the annual peak day data attained from the smart meter dataset;
- Deriving an outline set of industrial and commercial profiles (if sufficient data available); and
- Describing likely sources of error within the DEBUT LV design tool, such as any emergent properties generated by compound net LCT outputs from independent properties, and developing a pragmatic, representative approach for handling them using applied statistical experience from within the CLNR team.

National and International Standards

2.71 We have completed a report to provide a summary of European Standard Activities relating to Smart Grids. The review identified how the solutions being trialled as part of the CLNR project can influence European and International Standards. In summary the report identified that there is good communication channels in place between the ESOs and the IEC; there are very few published European Standards (EN); existing IEC standards can be used as a basis for the implementation of Smart Grids and noted that further work is required to develop existing standards for the implementation of Smart Grids in the future;

Commercial frameworks

2.72 We have published a report on existing commercial frameworks, the CLNR commercial arrangements study, which details the legislative and regulatory frameworks and analyses current commercial arrangements operating in the GB electricity market. The report identified what barriers the existing arrangements pose to both the deployment of network management and demand response technologies and also to innovative commercial offerings, such as TOU tariffs and load control incentives. Building on this, we have scoped a follow-on report 'Optimal Commercial Arrangements to Support Transition to Smarter Networks'.

Future asset specifications

2.73 Early in the project, we created new asset specifications for procuring the technologies for the network trials. Through the procurement, installation, commissioning and trialling of the equipment, we have generated a significant amount of learning which we are using to refine these specifications. At the end of this reporting period, we have started revising these specifications. We expect that the experience of the equipment during the network trials will lead to further revision, so we will publish the specifications when all the relevant learning has been assimilated into the specifications. These final specifications will be accompanied by reports on the design choices, the rationale behind the requirements within the specification documents, an overview of the equipment procured, and the lessons learnt from the design, specification, procurement and installation activities of learning outcome 3.

3. Consistency with full submission

3.1. The high level solution being demonstrated and the high level method being trialled in the project remain the same as set out in the full submission. In that document we set out what we would deliver in each of five learning outcomes and this has not changed. However, we have submitted to Ofgem a change request for an additional 12 months to complete the project and a restructuring of the budget. If this change request is approved we are confident that, by using the contingency budget and the efficiencies generated from the project to date, it will be possible to deliver the learning outcomes at the required level of quality within the original funding.

3.2. As is typical of such projects, not all the learning has taken the form originally envisaged. But the method is unchanged and the progress to date suggests that the value of the learning will be at least as good as that in the bid and quite likely better.

4. Risk management

4.1 This section provides an update on the key risks which affect, or might affect the delivery of the learning outcomes as described in the full submission. The key issues which have affected progress in the reporting period or which may present a challenge in the next reporting period are discussed in section 2.

4.2 We have encountered a number of issues and risks which have resulted in delays to the project, and we have submitted a change request to Ofgem requesting a one-year extension to the project which we consider to necessary to deliver the learning outcomes, and which reflects the additional time that was needed to successfully mitigate the issues and risks encountered. For this reason, we have not highlighted in this section issues and risks causing delay if these can be mitigated such that the whole project can still be delivered within this extra year.

4.3 The table below summarises the current most significant risks and also the status of the risks identified at the bid stage in box 26 of the full submission proforma. These are summarised in the following table and then discussed in more detail below. The full risk register is included in Appendix 2. The project has no procurement risks since all customer and network equipment and installation services have been procured.

Ref	Risk category	Risk	Risk Owner	Unmitigated risk			CURRENT Risk			Contingency Plan
				I	P	R	I	P	R	
1	Installation	Network Equipment may not operate as specified	Northern Powergrid	H	L	Red	M	L	Amber	For equipment that does not function as specified, consider simulation or modelling by DEI instead of field trials.
2	Installation	Possible failure to deliver the integrated demand response system	Northern Powergrid	M	M	Amber	L	L	Blue	Use manual processes instead to send the demand response signal.
3	Customer recruitment	Insufficient Customers Recruited for Test Cells	British Gas	H	H	Red	Risk closed.			
4	Other	British Gas withdraws from the project	Northern Powergrid	H	L	Red	Risk closed			
5	Other	Emerging findings indicate a major change of project scope is required	Northern Powergrid	M	M	Amber	Risk closed			
25	Installation	GUS Control System not function as designed.	Northern Powergrid	H	M	Red	M	L	Amber	Run the autonomous trials and as many of the collaborative trials as is possible using workarounds (would depend upon the extent of the problem). However, this would slow the rate at which we can work through those trials. Using the results of the autonomous trials, model the predicted results of the collaborative trials.
42	Customer Recruitment	Risk of customer drop out.	British Gas	M	H	Red	M	N	Blue	
43	Installation	DSR I&C test cell customers are located in un-monitored Network areas	Northern Powergrid	L	M	Amber	Risk has materialised. With the contingency measures, impact is low			Use simulation from DEI to match signals for DSR to customers and network monitoring.
44	Installation	Network Technology & GUS integration	Northern Powergrid	M	M	Red	M	N	Blue	In the event that the GUS to END device link does not work then the alternative trials strategy is to operate the END devices manually in the field and collect the trial

Ref	Risk category	Risk	Risk Owner	Unmitigated risk			CURRENT Risk			Contingency Plan
										result data locally.
45	Installation	Major Incident affecting trials equipment	Northern Powergrid	H	N	**Amber**	M	N	**Blue**	Reschedule and/or reduce numbers of physical trials, filling any gaps with simulation.
46	Installation	Timely commissioning of new network technology (Battery Systems and Transformers with OLTC)	Northern Powergrid	H	L	**Red**	Risk closed			
48	Other	Loss of academic personnel	DEI	H	H	**Red**	H	N	**Amber**	In the event that the project is extended but that staff /students leave before then, seek to replace personnel.

H = high, M = medium, L = low, N = negligible

Risk 1: Network equipment (EAVC, RTTR and storage) fails to operate as specified

4.4 At the time of the bid, we recognised that this was a high-impact risk. Some mitigation was built into the design of the project and the plan for its delivery; a preference for market ready products and, where possible, test bed operation followed by a phased roll out. The trials were designed to contain different combinations of equipment and network applications in order to avoid the risk associated with single point technical failure.

4.5 Where possible, we took action to further reduce the level of risk by identifying additional suppliers of equipment. For example, in the case of network monitoring equipment, we purchased and installed equipment from three different manufacturers. However, for some items, such as the storage devices, the practicality of this approach was limited by the long lead-time and cost and the availability of the small size storage devices.

4.6 Additional mitigation measures were incorporated into the solution design for the new technology at our primary sites and our switched capacitor station, where the new install is a dual redundant system incorporating traditional upgrade works in tandem with the alternative control system relays and communication system. If an item of equipment fails to operate as specified, we will investigate and take corrective action. In the event that, despite all the mitigation actions described above, equipment still fails to operate as specified, our contingency plan is to use simulation or modelling instead of field trials, where this is possible.

4.7 Over the course of the project, our knowledge of the equipment has increased and we have achieved successful bench and witness tests of the individual devices, and all the devices are now installed and operating with just one exception (see 2.28). Accordingly, we have reduced the overall risk rating from red to amber.

Risk 2: Failure to deliver the integrated demand response system

4.8 This risk was identified at the time of the bid. The demand side response platform will link the control system to the aggregators who will call the demand response from I&C/DG customers (test

cells 18 &19), and to the British Gas demand response host (Greencom) which will call demand response from domestic customers on the direct control trials (test cells 11a and 14). During the reporting period we have made good progress on developing the DSR platform: all the appliance functionality is in place for the direct control trials, and the GUS can now send signals to the British Gas demand response host to call direct control response and to the aggregators to call large scale demand-side response. This risk will remain until the full end to end system has been commissioned and proven to function as designed. If the demand response signals cannot be automated our contingency plan is to use manual intervention.

Risk 3: Insufficient numbers of customers are recruited

4.9 This risk was identified at the time of the bid. Although there were a number of external factors which made recruitment of large numbers of customers more difficult than we had envisaged, we took a number of actions which meant that we successfully overcame this such that we can deliver the learning outcomes set out in the bid. This is covered in more detail in the change request.

Risk 4: British Gas withdraws from the project

4.10 This risk was identified at the time of the bid. With the collaborative working relationship with British Gas and the evident high level of commitment to the project, this risk has been closed.

Risk 5: Emerging findings indicate a major change of scope is required

4.11 This risk was identified at the time of the bid. This risk has been closed since its probability is low and naturally diminishes with time. Indeed, with equipment designed, purchased and installed and customers recruited, should this risk materialise making any major changes of scope would not deliver benefits from the investment already made. Furthermore, giving due consideration to the findings from other studies would only serve to enhance the learning delivered from CLNR.

Risk 25: GUS control system not functioning as designed

4.12 The GUS control system with its blend of central and distributed control forms an important technical component in the coordination of individual network components and in facilitating network-to-customer communications. If the control system does not work as designed, it may not be possible to conduct the full suite of the network trials and customer intervention trials.

4.13 To reduce the probability of this risk materialising, we are working through the GUS system development and a commissioning strategy to confirm and deliver the required functionality. Progress on this is covered in 2.36 to 2.40).

4.14 Our contingency plan, in the event that this risk materialises is to run the autonomous trials and as many of the collaborative trials as is possible using workarounds, dependent upon the extent of the problem. However, workarounds would slow the rate at which we can work through the trials. Using the results of the autonomous trials, we will model the predicted results of the collaborative trials.

4.15 With the mitigating actions and contingency plan described above, we have reduced the risk rating from red initially to amber currently.

Risk 42: Customer dropout

4.16 There is a risk that customers drop out of the trials with the impact that the data sets collected will be smaller and cover a shorter time period. The probability and the impact are both generally greater in the intervention trials of learning outcome 2 than in the profiling trials of learning outcome 1 since the former require a greater degree of engagement from customers who are being asked to adopt new propositions. The impact would also be greater in test cells where the numbers of trial participants are relatively low.

4.17 To reduce the probability of this risk, we carried out a review of customer journeys and communications and issued an update / refresh communication to confirm the customer's position on vouchers, start dates, and installations. We are developing and will deliver an on-going 'in-life' communications programme to maintain customers' interest and commitment to the trials, including a newsletter for trial participants and, starting with TOU customers, personalized energy reports. In the event that customers drop out, we will continue to run the trials with the customers remaining i.e. we will not initiate a recruitment programme to replace the customers: our focus is on retention.

4.18 With the mitigating actions described above, and the generally low level of participants leaving the trial (see 2.5), we assess this risk as having been reduced from red to blue.

Risk 43: trial participants for large scale demand response trials are located in un-monitored areas

4.19 I&C and DG customers will be contracted to provide large scale DSR (test cells 18 and 19), but there is a risk that they may not be located in the network areas where we have installed monitoring (or may not remain contracted for sufficient time to warrant the time and cost of installing monitoring devices those areas of network. The impact of this is that DSR would not be called from a customer who was located on a specific area of network where we were signalling an artificial network constraint.

4.20 To mitigate this risk, we targeted recruitment at the areas where monitoring has been installed and at other areas where Northern Powergrid are forecasting loads approaching the substation firm capacity (e.g. Claywheels, Bottisford and Goole). This risk has materialised in that the recruited trial participants will not be in these areas, as customers connected to these primary substations did not wish to participate. Accordingly we have now executed our contingency plan which is to use data from the already monitored network locations to generate the signals required to call DSR from customers. We will still be able to demonstrate an end-to-end DSR processes, albeit that the simulated network constraint and the response requested from/delivered by a customer will be in different geographic locations. Modelling will then be used to combine the need and the response as if they were on the same area of network in order to evaluate its success.

Risk 44: Network technology & GUS integration

4.21 There is a risk that certain elements of the installed network equipment may not communicate or integrate correctly in every instance with the GUS control system & data warehouse. This would reduce the quality and quantity of the field trials.

4.22 All the interfaces have been between the GUS system and END devices have been commissioned, so the probability of this risk occurring is negligible. In the event that the GUS to END device link does not work to its full potential, our contingency plan is to operate the END devices manually in

the field and collect the trial result data locally. The risk rating has been reduced from amber to blue.

Risk 45: Major incident affecting trials equipment

4.23 There is a risk that major incident other extreme event affecting the trial network(s) will adversely affect the lead up to or execution of the network trials, causing delay to the project. In the unlikely event that this occurs, our contingency plan is to develop an alternative strategy to deliver the network trials by switching resources to other unaffected network areas, and/or reduce the physical trials, filling any gaps with simulation.

Risk 46: Commissioning new network technology (battery systems & transformers with OLTC) at all sites

4.24 We had identified a risk that approval from Northern Powergrid's Safety and Protection departments to connect the battery systems to the electrical network would not be obtained in time for the trials to commence. The equipment has been successfully connected, so this risk has been closed.

Risk 48: Loss of academic project personnel

4.25 Some of the academic staff working on the project are on fixed term contracts of employment which are aligned with the original project end date and there is a risk that some of these may leave before the end of the project since their contracts of employment cannot be extended to reflect a later project end date until this funding is secured by the University. A similar situation applies to PhD students working on the project. If the change request is approved, this would provide the funding stream to the University, which would then be in a position to extend contracts and studentships. However, there is a risk that these staff and students will leave before the change request process is concluded. This would have a significant impact on the project in terms of quality of the learning outcomes and delay.

4.26 To reduce the probability of this risk occurring, arrangements have been made which enable the university to extend contracts and studentships, in advance of the outcome of the change request process. The risk rating has therefore been reduced from red to amber.

5. Successful delivery reward criteria (SDRC)

5.1. We are set to achieve all the deliverables and activities referred to by the SDRC, although some of these will be later than the SDRC date due to the material changes in external circumstances, as set out in our change request.

5.2. The progress against each SDRC is set out in the table below:

SDRC type	SDRC description	SDRC date	Status
Dissemination activities	1st Regional stakeholder panel meeting held by end March 2011	31-Mar-11	Completed on time
Dissemination activities	Project website up and running by end May 2011 and updated in line with project developments	31-May-11	Completed on time

SDRC type	SDRC description	SDRC date	Status
Dissemination activities	1st Industry stakeholder forum held by end May 2011	31-May-11	Completed on time
Project milestone	Commence installation and commissioning of network equipment relating to learning outcome 3 – September 2011	30-Sep-11	Completed on time
Dissemination activities	2nd Regional stakeholder panel meeting held by end March 2012.	31-Mar-12	Completed on time
Dissemination activities	2nd Industry stakeholder forum held by end May 2012	31-May-12	Completed on time
Dissemination activities	1st Distributor project review meeting held by end July 2012	31-Jul-12	Completed on time
Project milestone	Complete installation and commissioning of network equipment relating to learning outcome 3 – December 2012	31-Dec-12	Running late due to issues with procurement and manufacture of network technology due to a variety of external factors which have been discussed in previous progress reports. This is one of the reasons for the project requesting a one year extension. This is covered in more detail in the change request.
Data sets	Demand profiles grouped by customer type by end 2012	31-Dec-12	Interim results published on time. A further publication of results will allow the development of profiles based on data collected over a longer time period. The customer trials are running behind the original plan due to a number of external factors which have been discussed in previous progress reports. This is one of the reasons for the project requesting a one year extension. This is covered in more detail in the change request.
Data sets	Demand profiles grouped by low-carbon technology type by end 2012	31-Dec-12	
Data sets	Output profiles of existing generation types by end 2012	31-Dec-12	
Data sets	Output/ demand profiles before and after a range of interventions by end April 2013	30-Apr-13	
Data sets	Network data showing performance of selected network technologies by end September 2013	30-Sep-13	Running late due to the delays in procurement of novel technology
Integration of network technologies	Provide an understanding of, and disseminate by end September 2013 to other distributors, how advanced voltage control, thermal ratings and storage may be integrated to enable more low-carbon technologies to be accepted on the network. Provide a view of the costs associated with these arrangements	30-Sep-13	
Dissemination activities	3rd Industry stakeholder forum held by end December 2013	31-Dec-13	Completed on time – see Appendix 3

SDRC type	SDRC description	SDRC date	Status
Dissemination activities	2nd Distributor project review meeting held by end December 2013	31-Dec-13	Completed on time on 2December 2013
Dissemination activities	3rd Regional stakeholder panel meeting held end December 2013.	31-Dec-13	Completed on time
Analysis of load profile data	Publish analysis of load profile data by end 2013	31-Dec-13	Running late due to other preceding aspects of the project running late
Analysis of generation profile data	Publish analysis of generation profile data by end 2013	31-Dec-13	
Commercial models arrangements	Undertake, and disseminate by end 2013 to other distributors, a critical review of how commercial models and arrangements between distributor and supplier may evolve to facilitate customer-side response	31-Dec-13	Running late due to other preceding aspects of the project running late
Project milestone	Project close down report produced – December 2013.	31-Dec-13	Running late due to other preceding aspects of the project running late

6. Learning outcomes

Learning outcome 1 (current and future load) and learning outcome 2 (customer flexibility)

Residential time of use tariff

6.1 As part of a courtesy call by British Gas to customers participating in the residential TOU tariff trial, a short telephone survey was carried out. The key findings were:

- 94% reported finding it possible to shift their energy usage
- 93% expressed an interest in remaining on the tariff
- 95% said that they would rather chose a multi rate tariff over a standard tariff if it were available post-trial
- 83% expressed an interest in the idea of a smart appliance that would schedule their operation according to their tariff

Social Science Update

6.2 In October 2013 we released the CLNR Social Science Interim Report 2 giving some indications of preliminary findings that can be drawn from the Social Science work that we have undertaken to date.

6.3 At this stage analysis of the qualitative data suggests that **the practices that are of most direct interest** in terms of contribution to current loads and their potential ability to play a part in demand side management of the electricity distribution network are household chores, cooking and dining, laundry and dish washing. The analysis we have conducted across the test cells suggests that there at least five key factors which determine energy use associated with practices in

domestic settings. Importantly, these are factors which affect electricity use for these practices prior to any trial interventions. The factors are: Ways Of Working; The Household; Materialities; Economies; and Habits and Norms. These factors certainly interact and affect different groups in different ways and are thus not presented as independent factors, and the possibility exists of analysis which seeks to understand how they combine to affect practices.

6.4 When considering domestic demand flexibility, for the most part, dining still takes place at conventional meal times, between 4pm and 7pm, and for most households this is firmly fixed in time. In contrast, the analysis suggests that household chores are an interesting collection of linked practices in that they are affected by a wide range of factors, and it is these practices that large groups of householders feel are least fixed. When talking about these activities, participants use either daily or weekly time-frames within which they may have proactive or reactive regimes for integrating these activities with wider household management and everyday life.

6.5 Our analysis suggests that participants trialling the TOU tariff are avoiding laundry, chores, and dish washing, and in some cases are cooking differently within and around the 4pm-8pm period, suggesting that the tariff is having an effect on these practices. In contrast we find that a financial incentive does not lead to a widespread shift in meal times. The results also confirm that the degree of alignment between the tariff and other schedules is important in shaping how and how much flexibility is realised.

6.6 We found on the trials that **smart meters** are viewed positively, are thought to be easy to understand and very few concerns were expressed by participants about privacy or health. We find that people use the **in-home display** (IHD) in at least three distinct ways; to manage the household economy, to provide oversight on what families are doing, and to challenge themselves' to save energy. Negative comments fall mostly into two categories; that their accuracy is not trusted and that engaging other family members with the IHD can be difficult.

6.7 Responses to the **heat pump trial** (test cell 3) recorded in the face-to-face research were less often positive. For some users the technology aligned to their needs, but for others the air source heat pump (ASHP) was unable to provide the kinds of energy services they demanded. Several had concerns about whether running the system all day would in fact incur additional costs while others sought to distance themselves from the technology, which was regarded as complicated to operate, leading to anxiety that their actions may lead to the breakdown of the system. Despite these negative sentiments in the customer responses, at the time of the interviews, most householders had reached a point where they were able to operate the system at a basic level.

6.8 The research made clear that context is critical for heat pumps. The potential for ASHP to actually increase energy consumption has led some researchers to conclude that depending on context, installation procedures and demographic factors, as well as variations in dwellings and the purposes they serve, a heat pump can be viewed as 'a wolf in sheep's clothing' (Christensen et al 2011)[8].

[8] Christensen, T.H., Gram-Hanssen, K., Petersen, P.E., Larsen, T.F., Gudbjerg, E., Rasmussen, L.S. and Munter, P. (2011). Air-to-air heat pumps: A wolf in sheep's clothing. In Energy efficiency first: The foundation of a low-carbon society. Proceedings of the ECEEE Summer Study 2011, Presqu'île de Giens, France, pp. 1963-1974.

6.9 We observe that as householders become familiar with and incorporate **generation systems** (in this case, PV) into their household practices there are indications of changes in the times that some household practices are occurring – principally use of white goods, showering and battery charging.

6.10 Participants of test cell 20 are encouraged to use PV power on-site. The trial of automatic water heating from surplus PV generation reveals only modest changes to practices and not all participants in this group attributed changes to the intervention. The small changes reported were most often related to when showers were taken. In contrast, when looking more specifically at evidence of changing practices to take advantage of the IHD we find that households are responding to the traffic light system of IHD. Households report that the device is easy to understand and has prompted them to make further changes to their practices. Often changes had originally been made as a result of the initial PV installation (prior to CLNR) but the IHD is associated with going further with these changes while for others the IHD identified new optimal alignments of PV and their practices. This suggests that IHDs are an essential adjunct to interventions for managing energy within the home and changing practices.

6.11 The value of the learning being generated is significant. It represents ground breaking internationally relevant research into customers' energy practices and is unmatched by any other learning currently available.

Heat Pump profiles

6.12 "Initial Heat Pump Load Profiles from CLNR Low Carbon Technology Trials". This report is being finalised prior to external publication. However, some initial findings are presented here. Preliminary analysis of data from up to 89 heat pumps for the period September 2012 to February 2013 suggests that mean heat pump demand on a day-by-day basis is very variable, with consumption peaks on the most highly or lowly loaded days being much higher or lower respectively than the overall monthly mean. This is unlikely to be surprising – heat pump electrical demand being temperature-dependent – but it does imply that the use of mean demand profiles for a group of heat pumps, even on a monthly basis, may be misleadingly low if used for network design purposes. A clear demand peak of about 1.5kW (mean) occurs at around 3am-4am. Previously this was thought to be caused by a defrost cycle, but this is now suggested to be the charging of the thermal store built in to the heat pumps on the CLNR trials. This peak is naturally greater in the winter. Work will continue in this area in the next reporting period.

6.13 We have presented two papers to the Nordic Environmental Social Science Conference 2013, Copenhagen, 11-13 June 2013,

a. "**Co-evolution of heating and hot water practices: rigidity, disruptions, and systemic challenges**", Ellis Judson, Harriet Bulkeley, Sandra Bell, Stephen Lyon, Gareth Powells. Drawing on findings from CLNR home tours, this paper investigates the interplay between technological interventions and everyday practices and socio-cultural norms, studying the evolution and impact of domestic heating and hot water provision following the installation of ASHPs in households involved in the CLNR project. The paper questions whether the introduction of new technology and accompanying information "loosen" daily household routines and habits or fosters pervasive socio-technical change. It suggests that the potential rearrangement of practices is disrupted not only by rigidity in conventions and habits around heating and hot water practices, but also commercial arrangements and systems of provision.

b. "**Prospecting for Flexibility: Findings from a Collaborative Enquiry into Smart Electricity Systems**", Gareth Powells, Harriet Bulkeley, Ellis Judson, Sandra Bell, and Stephen Lyon. Drawing on qualitative research on CLNR, this paper argues that flexibility can be understood as a form of social-technical capital produced by smart energy systems, and that the process of economisation of practices produces particular forms of flexibility which are not equally distributed within or between households.

6.14 We presented a paper at Energy Systems in Transition, Karlsruhe, Germany, 9th-11th of October 2013 "**FITTING SOLAR INTO THE SMART GRID: Systems of Provision and the Constitution of 'Smart' Electricity Conduct"** by H Bulkeley, G Powells, S Bell, E Judson, S Lyon. In this paper, we argue that future systems of electricity provision require an engagement with the ways in which new forms of 'smart' energy practice are being constituted as the means through which to realise the promises of smart grids. Drawing on theories of governmentality and of social practices, we argue that social practices critically mediate the ways in which smart grids are being realised. We consider how and with what implications households are 'fitting' smart grid interventions into everyday practices and how they relate to forms of energy investment conduct precipitated by the FITs. See para 6.15.e for the related book chapter.

6.15 The following academic journal papers and book chapters have been produced during the period

a. "**Fostering active network management through SMEs practices**" (in submission to *Energy Policy*) draws on analysis of the SME "energy tours" conducted as part of CLNR and presents a social practice-oriented theoretical perspective which enables us to a) see how and where energy is used, b) examine practice commonality across SMEs, and c) pinpoint which practices harbour potential flexibility. The paper concludes that for SMEs there is "no one size fits all" approach and different routes to flexibility for different activities across sectors are present. SMEs present an implacability in existing structures and systems that may counter attempts to introduce flexible practices. Potential opportunities for flexibility in electricity management could be achieved by re-shaping SMEs practices provided that interventions are tailored to specific needs.

b. "**The co-evolution of energy provision and everyday practice: rigidity, disruptions and systemic challenges in the installation of air source heat pumps in the North of England**" (in submission to *Research Policy*) presents a case-study of one of the CLNR clustered domestic heat pump installations and examines how the uptake of this new technology is shaped by energy services provision and everyday practices. The paper argues that we must understand the ways in which energy systems co-evolve through the habits and expectations of households, their technologies and appliances, and alongside large-scale socio-technical infrastructure. The study demonstrates that while retrofitting ASHPs has enforced some reconfiguration of domestic practices, resistance remains. A proportion of householders are found to be disengaged from their ASHP and thus are less empowered to manage their energy practices; this at a time when providers and intermediaries imagine ASHP technology to be an innovation for enrolling the participation of users in the overall system of energy provision.

c. "**Prospecting for Flexibility? Producing Socio-Technical Capital through Smart Electricity Demand Management Systems**" (in submission to *Economic Geography*) explores the economisation of demand flexibility, and argues that that thinking of flexibility as a form of

capital rather than as a commodity may open up possibilities for other forms of economic relationships and more socially and economically sustainable future arrangements. The paper draws on the CLNR domestic demand side response and solar trials, and uses the results of the CLNR home visit programme alongside quantitative investigations to draw conclusions.

d. "**Peak Demand and the Flexibility of Everyday Life**", in submission to *Geoforum*, investigates customer experiences of the CLNR residential TOU trial, and draws exclusively on the qualitative data from 186 research visits (semi-structured interviews) to 123 domestic research participants who were visited in summer 2012 and / or winter and spring 2013. The paper suggests that not all energy practices are equal in their relevance to peak demand debates and that those of most relevance, laundry and dish washing practices show most signs of being responsive to TOU pricing. In contrast, dining and cooking remain firmly rooted in the 4pm-8pm peak period, suggesting alternatives to financial incentives are required to reduce the electrical loads associated with the evening meal.

e. "**Smart Grids and the Constitution of Solar Electricity Conduct**", a chapter in an empirically diverse and conceptually rich themed book entitled *'Beyond Behaviour Change*', addresses smart grid and the governing of energy use. It draws on the CLNR PV trials and examines the ways in which participants responded to the different interventions in test cell 20. The chapter argues that smart grids intervene not only at network scales but also by recomposing the ways in which everyday practices are conducted; and that in the case of PV generation, new forms of self-government are being created within the household, caused by the interaction with the new technology. We anticipate that this book will become a significant volume in the contemporary understanding of energy use. An accompanying journal paper, "Smart grids and the governing of energy use: reconfiguring practices?", is also being produced as part of this work.

Learning outcome 3 - network flexibility

6.16 A significant amount of detailed learning has emerged during the design, procurement, installation and commissioning of the network technology. A comprehensive learning capture exercise has been and continues to be conducted throughout the various stages, which is being documented in a series of lessons learnt reports covering each network technology type. These documents are evolving as we progress into the network trials and will be published when the learning capture is complete. However, as the learning is captured, we are using it to inform our work on developing resources for adoption by other DNOs, such as policies, equipment specifications, training materials and the NPADDS design tool.

6.17 A core learning aspect which has applied across many technology types is that, given the trial nature of the project, the design specifications have often included stipulations above that required for BAU. For instance, capturing additional data points to allow detailed analysis of performance and the development of a data warehouse. Also, the necessity to develop and induct staff on all safety related information, including safety cases, safe systems of work, bespoke risk assessments and operational training courses for novel technologies places an additional burden that would not be present once the technologies become mainstream.

6.18 In order to ensure maximum learning from the trials of the CLNR we have developed a "Learning Credits" system that quantifies the learning achieved from trials. This ensures maximises the learning from the trials during the trial programme. A few of the key rules of the system are summarised below:

- The learning credits system acknowledges the importance of the first trial of a piece of a network intervention to achieve a specific control objective e.g. voltage or powerflow control on a network. Further trials of the same intervention on other areas of network have a lower learning credit value.
- Combinations of two or more network interventions trialled to achieve a specific control objective are worth more (a control objective might be voltage control or powerflow management). However, if the network interventions are not previously individually trialled on their own a penalty on the value of the learning credits for the trial, reflecting the uncertainty potentially introduced.
- Where a combination of control objectives are being trialled these trials will be worth more than the learning credits of single network management objective trials, reflecting the value of understanding how to simultaneously achieve multiple control objectives.

6.19 A paper on the design and development of the trial programme methodology and the VEEEG methodology detailed in the following section was presented at CIRED 2013, "**Programmatic Smart Grid Trial Design, Development and Analysis Methodology**" by P Lyons, P C Taylor, R Hetherington, D Miller, D Hollingworth, D Roberts. The trial design methodology provides a system to rationalise the number of trials carried out as part of the programme and ensure that the trials are as comprehensive as possible within the limited timescales of the CLNR project programme. The VEEEG methodology was shown to systematically augment and expand the results from the trial programme in order to provide robust findings regarding smart grid interventions and control system architectures, in future distribution networks with large quantities of embedded LCT.

Learning outcome 4 - optimum solution

6.20 We presented a number of papers at CIRED 2013, 22nd International Conference on Electricity Distribution

a. "**Using Real Time Thermal Ratings to Support Customers Under Faulted Network Conditions**" S Blake, P Davison, P Taylor, D Miller, A Webster. This estimates the number of hours during which thermal ratings would be exceeded in the event of a (n-1) fault on a double circuit supply using CLNR data. The paper concludes that this number could be reduced from 472 to 28 if RTTR were used in place of static ratings. This result suggests that the use of RTTR could be a viable alternative method of uprating the overloaded circuits, as compared with costly capital expenditure on network reinforcement. The study supports the use of RTTR, typically in combination with other smart grid technologies including network automation, or demand side participation, as an alternative to uprating the networks at an affordable cost.

b. "**Using Electrical Energy Storage to Support Customers Under Faulted Network Conditions**" by S Blake, J Yi, P C Taylor. This evaluates in terms of reducing the risk of customer disconnection following an (n-1) fault after installing an EES system connected to

the secondary busbar at a primary substation based on data and models developed in CLNR. The number of days per year on which such risk could be eliminated is shown to be a function of the size of both the converters and the battery. The detailed economic evaluation of electrical energy storage as a means of risk mitigation shows that such mitigation could not, on its own, justify the battery installation. However, it could contribute towards an economic justification which included other potential benefits of an EES system. These are interesting outputs from the project that exceed the learning commitments made at the bid stage.

c. "**Coordinated voltage and powerflow control in distribution networks**" by D H Liang, P C Taylor, L Wang. This proposes a new coordinated voltage and powerflow control method to help existing LV distribution network adapt to future scenarios with high penetrations of LCT loads and microgeneration which have been developed as part of CLNR. The evaluation and development of the control method was enabled by the Durham University Smart Grid laboratory and implemented Network-in-Loop emulations, the proposed method shows benefits over conventional methods in voltage control and power flow management.

6.21 "**Integrating Electrical Energy Storage into Coordinated Voltage Control Scheme for Distribution Networks**" has been accepted for publication in the March 2014 special issue on energy storage of IEEE Transactions on Smart Grids, demonstrating that the work is considered of archival value by the international community. A coordinated voltage control scheme utilizing electrical energy storage (EES) in future distribution networks with large, clustered distributions of low carbon technologies (LCTs) is presented. The benefits of the EES integrated scheme over conventional voltage control schemes are demonstrated through a set of scenarios on a case study network, both in simulation and in the laboratory using a network-in-loop setup. The case study uses a rigorously validated model of a Northern Powergrid network with multiple EES installations. It was found that the EES integrated voltage control scheme is able to provide increased capability over conventional voltage control schemes and increase the value of EES to network operation.

6.22 We have completed an internal report on trials of HV regulators in CLNR "**Initial Trial Analysis — HV Regulator Autonomous and Single + GUS Voltage Control at Denwick**". It can be seen from the studies that the application of HV voltage regulator in conjunction with GUS can increase allowable ASHP and EV connections significantly. However, the allowable PV connections cannot be increased, as the HV voltage regulator in the CLNR project can only boost the voltage. If extra tap positions are added to reduce the voltage at secondary side, the allowable PV connections can also be increased. By controlling the HV regulator with the GUS controller, additional LCTs can be connected in the HV feeder downstream cluster study. In the case of both ASHPs and EVs approximately 10% more can be connected. However, it is likely that a line drop compensation (LDC) algorithm might provide the same capability to accept extra LCT connections. However, no further LCT connections can be connected with the GUS controller in the HV feeder cluster study, due to the upstream voltage, the location and the tap position limits of the HV voltage regulator in the study.

6.23 We published a paper at ISGT Europe 2013 jointly with the Transport Operations Research Group (TORG) at Newcastle University, "**Integrating Smart Meter and Electric Vehicle Charging Data to Predict Distribution Network Impacts**" by Myriam Neaimeh, Robin Wardle, Phil Taylor, Phil Blythe,

Graeme Hill and Jialiang Yi. This paper joins EV charging data from the SwitchEV trials with customer demand data from the CLNR trials to create a peak winter loading case study of domestic EV charging. The CLNR trial networks in Wooler and Denwick, along with CLNR substation monitoring data from those networks, are used as "representative" case study networks to investigate the effects of various EV penetration levels. A probabilistic approach was used to create daily load curves for residential properties and EV charging, using the real trials data, and the study concluded that the rural network was likely to be more vulnerable to EV growth with power flow being the limiting factor in both networks. The urban network appeared more robust to EV growth than previous studies might have suggested.

6.24 We have prepared **a working paper on the development of the optimum solution**. This document identifies the links between the outputs of the VEEEG/post-trial analysis. The document identifies the pathways for the outputs of the VEEEG/post-trial analysis (which will include a review of techniques used in CLNR as deployed in other projects, to validate CLNR trials). The document also specifies bringing in the learning from a selection of other relevant projects using techniques not trialled in CLNR. The document specifies that the output, to satisfy the requirement for optimum solutions, include a merit order list of solutions, validated by CLNR and other projects. The solutions should consider practical implementation issues such as tolerable levels of risk, failure/degradation/back-up and future-proofing.

Learning outcome 5 - most effective delivery

Network Planning and Design Decision Support tool (NPADDS)

6.25 During the development of NPADDS it has become apparent that there is no standardised model (either publically available or proprietary) of representing electrical networks and customer data that is adequate for advanced network studies. We have used the Common Information Model (CIM) as a foundation and then expanded the library to meet the needs of an advanced modelling tool.

6.26 It has become clear that headroom can be released from network areas by taking an integrated approach to network modelling. New design tools have opened up the possibility of assessing MV (i.e. distribution HV and distribution EHV) and LV areas together. For instance, where parts of the MV network in FCO (First Circuit Outage) conditions show low voltage drops, it is possible to safely increase the permitted LV voltage drops without risk of voltage excursion.

6.27 Issues have arisen in the modelling of MV networks due to the dynamic nature of the connectivity (multiple switch points). It is necessary to assess an MV network in a variety of switch configurations to ensure resilience as per P2/6 can be achieved without voltage and thermal excursions. For a tool that is intended to run semi-automatically it is therefore necessary to either pre-configure sets of switch configurations, or use an algorithm to automatically generate the configurations. The latter approach is likely to generate some sets of switch settings that are unlikely to be used in practice. The assessment results for these unlikely configurations should be identified and discarded, which may defeat the objective of the time-saving aspect of the algorithm.

6.28 At this early stage in the GBs transition to a low carbon economy, it is prudent to develop tools with a high degree of flexibility. A tool developed solely based on today's knowledge will likely be

obsolete in a few years' time. Design and planning tools should be modular and the modules themselves should be modifiable.

6.29 The work to develop training matrices (which staff roles need to receive which knowledge) has identified that the time and cost of delivering training regarding smart technologies is significant. This learning became apparent from a practical perspective during the delivery of safety related training to operational staff within Northern Powergrid (see 2.31).

6.30 The original work to develop ACE49 used a 10% risk of load values being higher than the modelled load. The new assessment of load profiles and how these should feed into network design and planning activity has once again opened up a debate on the level of risk of overload and voltage

6.31 excursion that should be accepted. This has a direct effect on network reinforcement expenditure, system security and potentially safety.

6.32 We presented the following papers at CIRED 2013, 22nd International Conference on Electricity Distribution

a. "**Capacity Value of Distributed Generation for Network Capacity Planning**" by C Dent, P Davison, S Blake.

b. "**A Network Planning and Design Decision Support (NPADDS) tool for integration of low carbon technologies and solutions**" by D Hollingworth, R Mukherjee, G Hodges, D Miller, P Lyons.

Overview of overall approach to capturing the learning and dissemination

6.33 Our approach to capturing learning includes a review and write up at the end of key stages or activities in the project. For field work, an additional person on site as an observer can capture information in a way that is just not possible after the event and off site, discussing and noting activities and issues, and taking photographs and video footage.

6.34 Our approach to disseminating learning is underpinned by two main principles: delivering information according the type of audience and maximising the reach by using multiple channels. Our external contacts are segmented into 5 'clusters' to allow content to be adapted to be appropriate to each audience, and the same content is promoted via a number of external and internal channels such as press releases, email-shots, LinkedIn, Twitter, Northern Powergrid staff briefs, 'announcements' on the CLNR SharePoint site.

External dissemination

6.35 External dissemination uses a variety of channels: in person, via published materials including reports, presentations and videos, and via social media. There are 900 contacts on the CLNR communications mailing list, 212 members of the CLNR LinkedIn group and 206 followers on the CLNR twitter account, @CLNRUK. The CLNR YouTube channel, CLNRUK has 12 videos with approximately 8,500 views in total.

6.36 The following communications and dissemination activities have taken place during this reporting period. Materials marked * have been added to the CLNR website 'project library' for access by a wider audience.

date	type	Title/description
04/06/13	Event	Siemens Conference; Changing the world to smart technology
04/06/13	Stakeholder	Ofgem WS6 customer engagement workshop
06/06/13	PR	CLNR Regional stakeholder event; Regional forum shares latest smart grid project findings
10-13/06/13	Academic Conference	CIRED 2013 22nd International Conference & Exhibition on Electricity Distribution. 1. *Capacity value of distributed generation for Network Capacity Planning 2. *Coordinated Voltage and Power Flow Control in Distribution Network 3. *Programmatic Smart Grid Trial Design Development and Analysis Methodology 4. *Use of Real Time Thermal Rating To Support Customers Under Faulted Network Conditions 5. *Using Electrical Energy Storage to Support Customers Under Faulted Network Conditions 6. *A network planning and design decision support (NPADDS) tool for integration of low carbon technologies and solutions
10/06/13	Academic Conference	The Nordic Environmental Social Science Conference 2013 1. Co-evolution of heating and hot water practices: rigidity, disruptions, and systemic challenge 2. Prospecting for Flexibility: Findings from a Collaborative Enquiry into Smart Electricity Systems
17/06/13	Direct Publication	*CLNR-L036 Commercial Arrangements Study: Review of existing commercial arrangements and emerging practice
17/06/13	Conference	Distributed Energy Storage Conference: Integrating energy storage into the DNOs smart grid toolbox
18/06/13	Knowledge Sharing	The Malaysian National Utility
19/06/13	Video	CLNR Regional Stakeholder Forum
20/06/13	Stakeholder	Ofgem WS6 industrial & commercial DSR trials presentation
20/06/13	PR	Solar users helping to shed light on future energy needs
21/06/13	PR	Regional forum shares latest smart grid project findings
24/06/13	PR	Newcastle Journal; regional forum shares latest smart grid project results
25/06/13	Conference	European Demand Response and Dynamic Pricing
27/07/13	Direct Publication	*CLNR-G016 Progress Report 5
28/06/13	Stakeholder	CLNR model demonstration at Ofgem offices in London

08/07/13	Feature Article	Utility Business Magazine
09-11/07/13	Event	The Great Yorkshire Show
15/07/13	PR	CLNR demand side response commentary piece
17/07/13	Communications	CLNR Information Pack
19/07/13	Stakeholder	CLNR model demonstration for Chris Davies MEP at EATL offices
24/07/13	Direct Publication	*CLNR-L036 Project Lessons Learned from Trial Recruitment
15/08/13	PR	CLNR smart washing trials; Europe's smartest washing machine lands in UK homes
September 2013	Publication	CLNR referenced and diagram from *CLNR-L036 replicated in the Australian Institute of Energy's Journal.
04/09/13	PR	Low carbon project celebrates customer recruitment milestone
05/09/13	PR	CLNR's participation in the British Science Festival
06/09/13	PR	CLNR National knowledge sharing event; smart grid event shares emerging consumer energy trends
09/09/13	Event	British Science Festival 2013 Making Waves: Energy & Society
11/09/13	PR	Joint PR: PassivSystems technology shines a light on UK domestic energy consumption
12/09/13	Event	Innovate NE
12/09/13	Event	British Science Festival 2013 Newcastle: The smart future city
16-18/09/13	Conference	NEA Annual Conference 2013 attended by Dr Gareth Powells, Dr Liz Sidebotham, Dr John Bird, and David Lynch
20/09/13	Conference	DECC British Energy Challenge Roadshow, Newcastle upon Tyne
25/09/13	PR	CLNR National knowledge sharing event; speakers line up to switch on to Customer-Led Network Revolution
01/10/13	Stakeholder	*CLNR National knowledge sharing event; results from our customer facing trials

October 2013	Publication	CLNR referenced and data published in an Ecuity report for the Micropower Council & Electricity Storage Network entitled: Smart Grids, Microgeneration & Storage: Commercialising the benefits
October 2013	Publication	CLNR report referenced in a CEER public consultation document entitled: Regulatory and Market Aspects of Demand-Side Flexibility
06-09/10/13	Academic Conference	IEEE PES ISGT Europe 2013 *Integrating Smart Grid and Electric Vehicle Charging Data to Predict Distribution Network Impacts.
09-11/10/13	Academic Conference	Energy Systems in Transition Karlsruhe, Germany. FITTING SOLAR INTO THE SMART GRID: Systems of Provision and the Constitution of 'Smart' Electricity Conduct
16-17/10/13	Conference	IET Power in Unity London, UK. Delivering the UK's biggest Active Network Management system (GUS)
21/10/13	PR	CLNR National knowledge sharing event; capacity crowd hears latest findings from £54m smart grid project
22/10/13	Video	National Stakeholder Forum
22/10/13	Conference	Major Energy Users Council Conference
22/10/13	Stakeholder	WebEx broadcast and presentation to GE's global office network
23/10/13	Article	Newcastle Journal: A smarter way to help slash energy bills in the North East
24/10/13	Stakeholder	Presentation to the Smart Demand Forum; results from customer trials
30/10/13	Direct Publication	*CLNR-L037 Social Science Interim Report 2
01/11/13	Article	Energy World Magazine:How will domestic consumers react to smart systems?
06/11/13	Knowledge Sharing	Manchester Electrical Energy and Power Systems Workshop (MEEPS)
07/11/13	Newsletter	*CLNR Newsletter Issue 4
11/11/13	Article	Demand side response article for the Major Energy Users Council members magazine
13-15/11/13	Conference	Energy Networks Association LCNF 2013 Conference
18-19/11/13	Academic Conference	First workshop on Modelling Social Energy Practices, Centre for Research in Social Simulation, University of Surrey. Attended by Dr Jamie Lawson, Anthropology Department, Durham University

Internal dissemination

6.37 As with external dissemination, dissemination within Northern Powergrid uses a variety of channels and formats. This includes communications with staff from key functions involved in delivering the project or who are involved in the development and approval of key deliverables, as well as communications for staff in specific functions regarding transition into business as usual, and for staff in general.

6.38 We hold user forums to ensure that the outputs of the project, including policies, equipment specifications, commercial propositions, training materials and design tools, will be fit for purpose. We use Northern Powergrid's operational and safety seminars and specially prepared materials for control and field operations staff focussing mainly on the new technologies that staff might see to enable them to recognise, understand and safely operate the equipment. Members of the CLNR team also participate in, or lead events with the management team or with specific functions (such as call centre, network trading, design etc.). Some of these cover the whole breadth of the project, whereas others focus on specific areas e.g. with design staff, we focus on potential changes to policy and the development of NPADDS.

6.39 We have also issued a six Northern Powergrid staff briefs, delivered to all staff, to keep them up to date with project progress, highlights and findings. Internal dissemination activity within British Gas included Dr Gareth Powells and Professor Harriet Bulkeley of Durham University participating in their 'Connected Homes' event.

7. Business case update

7.1. The business case presented in the full submission proposal was based on delivering an estimated £14.3bn of net financial benefits, including 43.5MtCO_2 benefits, to GB consumers over the period 2020 – 2050. This was based on the solutions being delivered by the project being applicable to 80% of GB networks and being adopted such that the uptake of low carbon technologies can be accelerated by one year.

7.2. The change request which we have submitted does not result in a change to the estimate of this benefits case. This is because the proposed project changes are expected to deliver the originally intended learning and customer benefits, as described in the original proposal. The only difference is that they will be delivered 12 months later than had been anticipated under the original timetable. However, given the methodology used to assess the original business case, a delay of this length would not impact on the estimate of benefits. This is because no benefits were assumed to flow until 2020, given the conservative assumptions that were used about the speed of roll-out of low carbon technologies. Since the learning from CLNR will be complete by the end of 2014 we consider there is sufficient time to ensure the learning could be implemented in advance of 2020. Consequently, if we were to rerun the analysis with the same inputs there would be no change in the benefits reported.

7.3. We recognise that it will also be important to update the business case to reflect more recent forecasts of input data and to utilise the more sophisticated tools now available to evaluate the benefits that we expect to be delivered by this project (such as the EA Technology's Transform™ model). We plan to undertake this exercise and include the results as part of the project closedown report.

8. Progress against budget

8.1. The project budget is currently 79.6% spent and we forecast that the budget is sufficient to deliver the full scope of the project even with the project closedown forecast to be one year later than the original plan.

Cost Category	Costs to Date (Nov-13)	Project Direction	Project Direction inc agreed transfer	Current Forecast	Costs to complete (Dec-13 to Dec-14)	Variance of revised budget against project direction plus agreed transfer		Variance of current forecast relative to forecast in May 2013 report		
								May 13 Forecast	Variance	
	£m	£m	£m	£m	£m	£m	%	£m	£m	%
Box 6 (Employment costs)	2.812	3.480	3.480	4.501	1.689	1.021	29%	4.584	(0.083)	-2%
Box 7 (Equipment costs)	11.971	11.025	12.125	12.624	0.653	0.499	4%	12.095	0.529	4%
Box 8 (Contractor costs)	9.476	11.397	10.297	12.326	2.850	2.029	20%	12.332	(0.006)	0%
Box 9 (Customer and user payments)	0.311	0.768	0.768	0.444	0.133	(0.324)	-42%	0.462	(0.018)	-4%
Box 10 (Other costs)	0.148	4.364	4.364	1.139	0.991	(3.225)	-74%	1.561	(0.422)	-27%
Total costs	**24.718**	**31.034**	**31.034**	**31.034**	**6.316**	**(0.000)**	**0.00%**	**31.034**	**0.000**	**0%**

*A £1.1m transfer of costs from box 8 to box 7 has been agreed by Ofgem since the project direction.

8.2. Note that most of the reduction in 'other costs' is due to the reallocation of £2.6m of contingency from 'other costs' to costs in other budget categories

9. Bank account

9.1. Deloitte conducted a review of the transactions on the memorandum account for the reporting period. The outcome of this review was successful and no significant issues were noted. The report received from Deloitte can be viewed within Appendix 1a.

9.2. Confidential Appendix A: Memorandum Account Transactions lists the transactions between 1 June 2013 and 30 November 2013.

10. Intellectual Property Rights (IPR)

10.1. No IPR have been registered or royalties earned in this reporting period, and we forecast the same for the next reporting period.

11. Other

11.1. Further supporting information has been included within the report as appendices, which are as follows:

- Appendix 1a: Deloitte audit statement – memorandum account transactions
- Appendix 1b: Deloitte audit statement – financial tracking and reporting system
- Appendix 2: Project risk register
- Appendix 3: SDRC evidence – 3rd industry stakeholder forum
- Appendix 4: LO1 & LO2 trials – specification and participation in each test cell

12. Accuracy assurance statement

12.1 The approach taken to ensuring the accuracy of the information contained in this report is based on building in quality to the whole process/lifecycle of the progress report and the data and information contained therein. This quality assurance is provided by the following processes and controls:

- The integrity of the underlying systems and professional competence of the staff involved.
- Referencing existing 'within project' reports, records and materials to avoid errors or omissions.
- Independent checking of the financial aspects of the report, by Northern Powergrid staff where appropriate and by external auditors where mandated (i.e. the Project Bank Account transactions).
- Regular scheduled review of the project financial data with the senior Northern Powergrid financial staff including the Finance Director.
- Review by project board members who represent a wide range of interests and competencies and include representatives from all four project partners.
- Approval by the executive board, providing senior management endorsement by all four project partners in addition to the Accuracy Assurance Statement from a Northern Powergrid board director

12.2 The key steps in this approach are:

Step	Rationale
Content has been contributed by project personnel according to their areas of responsibility and expertise. The financial sections of the report are prepared by a chartered accountant.	This provides confidence in the capability of the responsible staff to produce a meaningful and accurate report.

Step	Rationale
External auditors have certified Northern Powergrid's accounting arrangements for the project as being satisfactory, and revisit this on an annual basis (i.e. the provision of the annual report to Ofgem to confirm compliance with the requirements set out in the Bank Accounts section of the Project Direction). The most recent annual audit was undertaken in December 2013 and is included as Appendix 1b.	This provides confidence that sources of data for the financial aspects of the report are indeed reliable.
Responsibility for preparing the financial sections of the report has been allocated to the project accountant who is a chartered accountant.	This provides confidence that the financial aspects of the report are professionally prepared.
The schedule of memorandum account transactions is audited by Northern Powergrid's external auditors.	Required by the Project Direction, this provides confidence in this aspect of the report.
As part of our quality assurance process, we will check that the actual expenditure figures in 'Progress Against Budget' reconcile with records in Northern Powergrid financial systems and this check will be carried out by a person other than the person who has prepared this information for inclusion in the report.	This reduces the possibility of human error.
The report is reviewed by all members of the project board and approved by the executive board. Both the project board and the executive board include representatives from each project partner including Northern Powergrid. Members of the Executive Board are at director level in their respective organisations.	This ensures that the report is comprehensive and balanced.

12.3 Sign off: I confirm that the processes in place and steps taken to prepare this report are sufficiently robust and that the information provided is accurate and complete.

Signature

John Barnett

Commercial Director
20 December 2013

Appendix 1a: Deloitte audit statement – memorandum account transactions

Deloitte.

Deloitte LLP
One Trinity Gardens
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The Board of Directors
Northern Powergrid (Northeast) Limited
Lloyds Court
78 Grey Street
Newcastle upon Tyne
NE1 6AF

OFGEM
9 Millbank
London
SW1P 3GE

6 December 2013

Dear Sirs

Northern Powergrid (Northeast) Limited ("the Company") – Customer-led Network Revolution Project ("the Project"): Memorandum Account Transactions Report of Factual Findings

We have performed the following procedures as agreed by Northern Powergrid (Northeast) Limited ("the Company") and OFGEM on the schedule of information provided by the Directors of the Company ("the Schedule") in accordance with our engagement letter dated 3 October 2013, a copy of which is attached. The procedures were performed solely for the purpose of assisting the Company with their compliance with Clause 3.82 of the LCN Fund Governance Document.

Scope of our work and factual findings

The procedures performed and the results were as follows:

Procedures	Results
Obtain a schedule of all the memorandum account transactions for the Project for the six month period ended 30 November 2013.	We obtained the Company's schedule for the 6 month period ended 30 November 2013.
Ensure that the schedule includes interest and confirm that this has been calculated according to the rate project funds would earn on the open market (i.e. in a separate bank account).	As the funds related to the project are held within the Company's current account, the schedule shows interest which has been calculated on a daily basis by reference to the closing balance of funds related to the Project, and the interest rate applying to the main current account. We obtained confirmation of the interest rates from the Company's treasury function, and we have gained confirmation that the transactions are related to the Project by the testing below.
Select a sample of 25 transactions from the schedule and perform the following:	

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1.	Agree the details of the transaction to supporting documentation;	All transactions have been agreed to relevant documentation.
2.	Agree the transaction to the bank account of the Company; and	All transactions have been agreed to bank statement.
3.	Confirm that the transaction relates to the Project.	All transactions have been confirmed as relating to the project.

The scope of our work in preparing this report ("Report") was limited solely to those procedures set out above. Accordingly we do not express any opinion or overall conclusion on the procedures we have performed. You are responsible for determining whether the scope of our work specified is sufficient for your purposes and we make no representation regarding the sufficiency of these procedures for your purposes. If we were to perform additional procedures, other matters might come to our attention that would be reported to you.

Our Report should not be taken to supplant any other enquiries and procedures that may be necessary to satisfy the requirements of the recipients of the Report.

The procedures we performed did not constitute a review or an audit of any kind. We did not subject the information contained in our Report or given to us by the Directors to checking or verification procedures except to the extent expressly stated above. This is normal practice when carrying out such limited scope procedures, but contrasts significantly with, for example, an audit. The procedures we performed were not designed to and are not likely to reveal fraud.

The audit work of Deloitte LLP on the financial statements of the Company was carried out in order to report to the Company's members as a body in accordance with the statutory obligations under Chapter 3 of Part 16 of the Companies Act 2006 and is subject to a separate engagement letter. The audit work was undertaken to state to the Company's members those matters required to be stated in an auditor's report and for no other purpose. The audits of the Company's financial statements were not planned or conducted to address or reflect matters in which anyone other than such members as a body may be interested.

In particular, the scope of the audit work was set and judgements made by reference to the assessment of materiality in the context of the audited accounts taken as a whole, rather than in the context of the Report contemplated in this letter. Deloitte LLP have not expressed an opinion or other form of assurance on individual account balances, financial amounts, financial information or the adequacy of financial, accounting or management systems.

Deloitte LLP do not accept or assume responsibility to anyone other than the Company and the Company's members as a body, for their audit work, for their audit report or for the opinions they have formed. To the fullest extent permitted by law, Deloitte LLP do not accept or assume responsibility or liability to anyone by virtue of this engagement or our Report in relation to our audits of the Company's financial statements.

Deloitte.

In particular, the scope of the audit work was set and judgements made by reference to the assessment of materiality in the context of the audited accounts taken as a whole, rather than in the context of the Report contemplated in this letter. Deloitte LLP have not expressed an opinion or other form of assurance on individual account balances, financial amounts, financial information or the adequacy of financial, accounting or management systems.

Deloitte LLP do not accept or assume responsibility to anyone other than the Company and the Company's members as a body, for their audit work, for their audit report or for the opinions they have formed. To the fullest extent permitted by law, Deloitte LLP do not accept or assume responsibility or liability to anyone by virtue of this engagement or our Report in relation to our audits of the Company's financial statements.

Use of Report

Our Report has been prepared solely for your exclusive use and solely for the purpose of confirming existence of a financial tracking and reporting system for the Customer-led Network Revolution Project. Our Report is not to be used for any other purpose, recited or referred to in any document, copied or made available (in whole or in part) to any other person without our prior written express consent. We accept no duty, responsibility or liability to any other party in connection with the Report or this engagement.

Yours faithfully

Deloitte LLP
Chartered Accountants
Newcastle upon Tyne, United Kingdom

Appendix 1b: Deloitte audit statement – financial tracking and reporting system

Deloitte.

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9 Millbank
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SW1P 3GE

6 December 2013

Dear Sirs

Northern Powergrid (Northeast) Limited ("the Company") – Customer-led Network Revolution Project ("the Project"): Financial Tracking and Reporting Systems Report Report of Factual Findings

We have performed the following procedures as agreed by Northern Powergrid (Northeast) Limited ("the Company") and OFGEM in accordance with our engagement letter dated 3 October 2013, a copy of which is attached. The procedures were performed solely for the purpose of confirming existence of a financial tracking and reporting system for the Customer-led Network Revolution Project.

Scope of our work and factual findings

The procedures performed and the results were:

Procedures	Results
Obtain an understanding of the financial tracking and reporting system by obtaining the Company's documentation of the systems and processes and discussion with management. This may also require, where relevant, reconciling the account to underlying accounting records or other supporting documentation.	We have reviewed documentation provided by the Company and held discussions with management in order to obtain an understanding of the financial tracking and reporting system.
Perform a walkthrough of the operation of the financial tracking and reporting system and document whether the operation is in line with item 1 above.	Performed with no issues noted.
Via discussions with the Company, and demonstration of the system via walkthrough, confirm whether the financial tracking and reporting system can:	
1. show all transactions relating to (and only to) the Project;	Performed with no issues noted.

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2.	be capable of supplying a real time statement (of transactions and current balance) of the Project at any time;	Performed with no issues noted.
3.	accrue expenditures when a payment is authorised (and subsequently reconciled with the actual bank account);	Performed with no issues noted.
4.	accrue payments from the moment the receipt is advised to the bank (and the subsequently reconciled with the actual bank);	Performed with no issues noted.
5.	calculate a daily total; and	Performed with no issues noted.
6.	calculate interest on the daily total according to the rules applicable to the account within which the funds are actually held.	Performed with no issues noted.
Obtain a statement(s) from the memorandum account system as at 30 November 2013 as support for the findings.		Statement obtained with no issues noted.

The scope of our work in preparing this report ("Report") was limited solely to those procedures set out above. Accordingly we do not express any opinion or overall conclusion on the procedures we have performed. You are responsible for determining whether the scope of our work specified is sufficient for your purposes and we make no representation regarding the sufficiency of these procedures for your purposes. If we were to perform additional procedures, other matters might come to our attention that would be reported to you.

Our Report should not be taken to supplant any other enquiries and procedures that may be necessary to satisfy the requirements of the recipients of the Report.

The procedures we performed did not constitute a review or an audit of any kind. We did not subject the information contained in our Report or given to us by the Directors to checking or verification procedures except to the extent expressly stated above. This is normal practice when carrying out such limited scope procedures, but contrasts significantly with, for example, an audit. The procedures we performed were not designed to and are not likely to reveal fraud.

The audit work of Deloitte LLP on the financial statements of the Company was carried out in order to report to the Company's members as a body in accordance with the statutory obligations under Chapter 3 of Part 16 of the Companies Act 2006 and is subject to a separate engagement letter. The audit work was undertaken to state to the Company's members those matters required to be stated in an auditor's report and for no other purpose. The audits of the Company's financial statements were not planned or conducted to address or reflect matters in which anyone other than such members as a body may be interested.

Deloitte.

Use of Report

Our Report has been prepared solely for your exclusive use and solely for the purpose of assisting the Company with their compliance with Clause 3.82 of the LCN Fund Governance Document. Our Report is not to be used for any other purpose, recited or referred to in any document, copied or made available (in whole or in part) to any other person without our prior written express consent. We accept no duty, responsibility or liability to any other party in connection with the Report or this engagement.

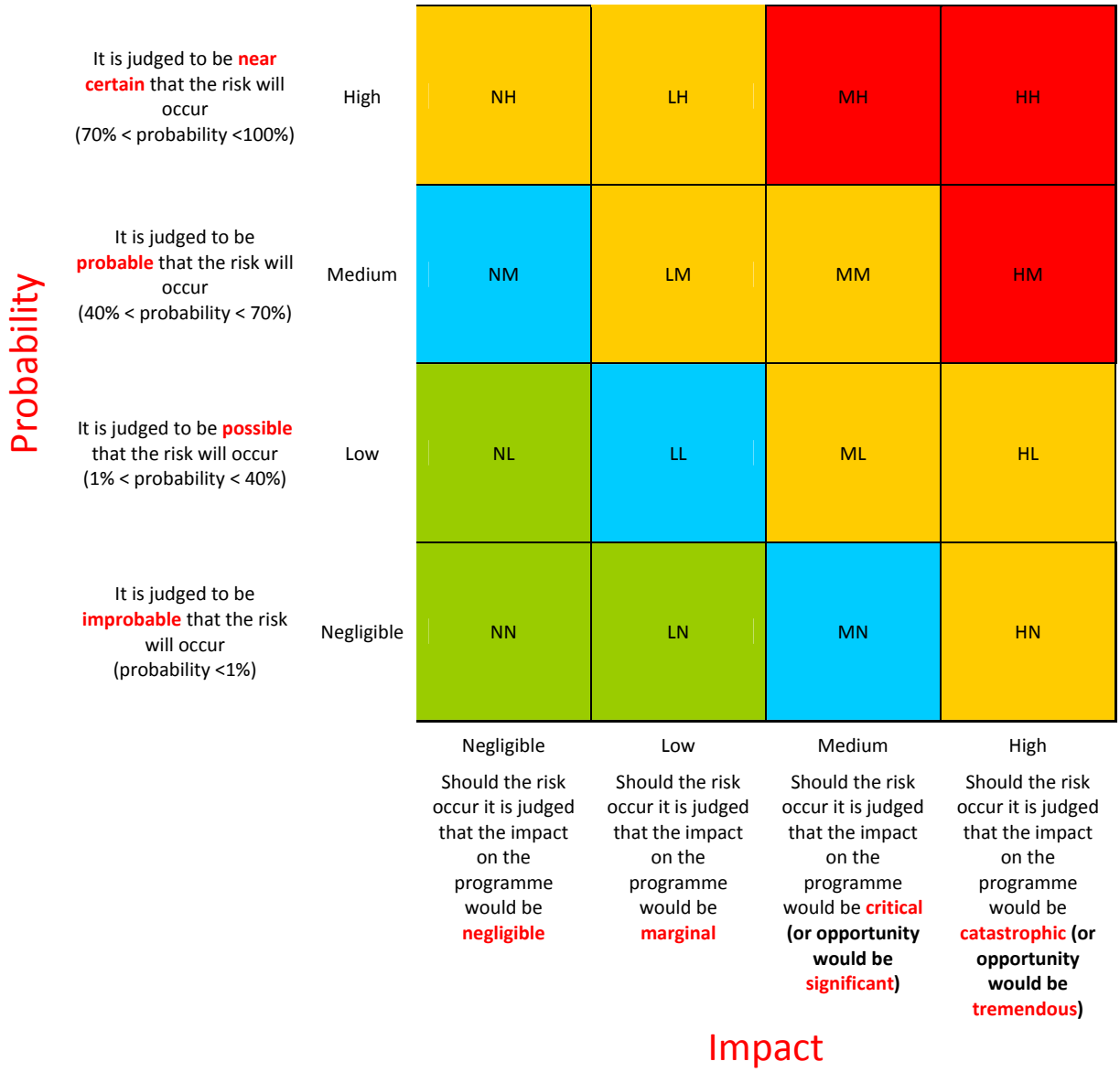
Yours faithfully

Deloitte LLP
Chartered Accountants
Newcastle upon Tyne, United Kingdom

Appendix 2: Project risk register

Risk rating system

The following matrix illustrates the risk rating system used, i.e. the probability and impact of a risk combine to give a risk rating of red, amber, blue and green.



The following pages are an extract of the project risk register for all active risks.

Ref	Ofgem category	Risk Definition & Summary Description	Risk Owner	Unmitigated risk			Risk Mitigation Response	CURRENT Risk			Contingency Plan
				I	P	R		I	P	R	
1	Installation	**Title: Network Equipment may not operate as specified** **Impact:** If items of network equipment (EAVC, RTTR and storage) fails to operate as specified, this would affect our ability to conduct the field trials with said equipment. This would prevent the operation of or invalidate the results of certain test cells.	Northern Powergrid	H	L	**Red**	Preference for market ready products, multiple suppliers, test bed operation and phased rollout. Trials have been designed to contain different combinations of equipment and network applications in order to diversify the overall risk of single point technical failure. Investigate failures and take corrective action.	M	L	**Amber**	For equipment that does not function as specified, consider simulation or modelling by DEI instead of field trials.
2	Installation	**Title: Possible failure to deliver the integrated demand response system** **Impact:** Failure to deliver the system (and/or it does not operation as required) would affect our ability to conduct automated end to end trials for domestic /SME direct control trials and I&C/DG DSR (test cells 18 &19).	Northern Powergrid	H	M	**Red**	Development and testing of the automated signalling between the various components.	L	L	**Blue**	Use manual processes instead to send the demand response signal.
25	Installation	**Title: GUS Control System not function as designed.** **Impact:** The control system will form an important technical component in the coordination of individual network components and in facilitating network-to-customer communications. We envisage a hybrid approach using both forms of control architecture, and have observed that there is no single vendor offering an off-the-shelf turn-key solution to integrate all elements of the control system from network component to individual customers in this manner. If the control system does not work as designed it will not be possible to conduct the full suite of network trials under the control of GUS, so the learning outcomes of LO3, and consequently the outputs in LO4 and LO5, will be compromised.	Northern Powergrid	H	M	**Red**	We are working through the GUS system development and a commissioning strategy to confirm the functionality of the GUS product to be installed meets the requirements of all project partners to successfully deliver the trials and the learning outputs. A new cross-party working group has been set up by NPG and closer working with Siemens has been initiated, with weekly conference calls, reports and increased senior level project visibility.	M	L	**Amber**	Run the autonomous trials and as many of the collaborative trials as is possible using workarounds (will depend upon the extent of the problem). However, this will slow the rate at which we can work through those trials. Using the results of the autonomous trials, model the predicted results of the collaborative trials.

Ref	Ofgem category	Risk Definition & Summary Description	Risk Owner	Unmitigated risk			Risk Mitigation Response	CURRENT Risk			Contingency Plan
				I	P	R		I	P	R	
42	Customer Recruitment	**Risk of customer drop out** Some domestic and SME customers have complained of inadequate communications and as result they are disengaged and considering withdrawal from the project. If trust and engagement is not established and maintained, there is a risk that customers drop out of the trials. The impact would be that the data sets collected will be smaller and cover a shorter time period. The probability and the impact are both generally greater in LO2 than in LO1 since a greater degree of engagement is required since customers are being asked to adopt new propositions. The impact will also be greater in test cells where the numbers of trial participants are relatively low.	British Gas	M	H	**Red**	To reduce the probability of this risk, BG and BGB should initiate an internal review of customer journeys and communications and in the short term issue an update / refresh communication to confirm customer position in regard to vouchers, start dates, installs. LO1 Customers need: Update on Voucher, trial status, installation status. LO2 Customers need: the above plus a reminder of proposition. Installers need: Clear, detailed instructions about each installation and how it relates to the customer and the trial, proposition, test cell. In the longer term, develop and deliver an ongoing 'in-life' communications programme to maintain customer interest and commitment to the trial.	M	N	**Blue**	
43	Customer Recruitment	**DSR I&C test cell customers are located in un-monitored Network areas** I&C and DG customers will be contracted to provide DSR, but there is a risk that these may not be located in the network areas where we have installed monitoring (or may not remain contracted for sufficient time to warrant the time and cost of installing monitoring devices those areas of network).	Northern Powergrid	L	M	**Amber**	We will target recruitment at the areas where monitoring has been installed and at other areas where Northern Powergrid are planning investment plan (Claywheels, Bottisford and Goole).	L	L	**Blue**	Wherever this is not possible then use simulation from DEI to match signals for DSR to customers and Network Monitoring.
44	Installation	**Network Technology & GUS integration** Risk that certain elements of the installed network equipment may not communicate / integrate in every instance with the GUS control system & data warehouse. This would reduce the quality and quantity of field trials delivered	Northern Powergrid	M	M	**Red**	We are working through the GUS system development and bench testing of the Control Systems and END devices in order to reduce the risk and impact of occurrence.	M	N	**Blue**	In the event that the GUS to END device link does not work then the alternative trials strategy is to operate the END devices manually in the field and collect the trial result data locally.

Ref	Ofgem category	Risk Definition & Summary Description	Risk Owner	Unmitigated risk			Risk Mitigation Response	CURRENT Risk			Contingency Plan
				I	P	R		I	P	R	
45	Installation	**Major Incident or Disruptive Failure of trials equipment** A major incident other extreme event affecting the NPG trial network will adversely affect the lead up to or execution of the network trials, causing delay.	Northern Powergrid	H	N	**Amber**	Liaise with Control Operations to develop an alternative strategy to deliver the network trials by switching resources to other unaffected network areas, or reduce trials,	M	N	**Blue**	Reduce numbers of trials. Fill any gaps with simulation
46	Installation	**Commissioning New Network Technology (Battery Systems and Transformers with OLTC) at all sites.** Risk that approval from Northern Powergrid Safety and Protection departments will not be forthcoming to connect the battery systems to the electrical network in time for the trials to commence.	Northern Powergrid	H	L	**Red**	Working parties and Safety and Guidance operations documents have been written to satisfy Northern Powergrid's Safety and Operations departments	N	L	Green	Reduce numbers of trials. Fill any gaps with simulation
48	Other	**Title: Loss of academic personnel Impact: P**roject is delayed and quality of learning is adversely affected.	DEI	H	H	**Red**	In parallel with agreeing the change request, explore arrangements which could enable DEI to extend fixed-term contracts for academic staff and PhD studentships which would otherwise expire prior to the end of the project.	H	N	**Amber**	In the event that the project is extended but that staff/students leave before then, seek to replace personnel.

Customer-Led Network Revolution

Appendix 3: SDRC evidence – third national stakeholder forum

On Tuesday 1st October 2013, the Customer-Led Network Revolution team held a national knowledge sharing event, fulfilling the Successful Delivery Reward Criterion of holding a regional stakeholder forum by December 2013.

The event was held at One Great George Street, Westminster, London. Over 100 delegates attended on the day, from organisations including; Ofgem, ENA, all UK DNOs and energy suppliers, various academic institutions and consumer organisations.

The event focused on sharing the latest learning from our CLNR customer facing trials. The presentations on the day were as follows;

- **Why CLNR matters; what the project means for Northern Powergrid and GB consumers**
  Phil Jones, Chief Executive, Northern Powergrid
- **How CLNR is delivering; project overview, progress and outlook**
  Jim Cardwell, Head of Regulation & Strategy, Northern Powergrid
- **Why 12,000 customers joined the revolution**
  Stavros Sachinis, Project Manager, British Gas
- **Demand side response trials with industrial and commercial customers**
  Chris Thompson, LCNF Programme Manager, Northern Powergrid
- **Engaging consumers in the smart grid**
  Professor Harriet Bulkeley and Dr Gareth Powells, Durham University
- **Emerging conclusions from the quantitative data**
  Professor Phil Taylor, Newcastle University
- **Development of practical project outputs**
  Mark Drye, Director of Asset Management, Northern Powergrid

Each presentation was followed by a short Q&A session. The day culminated with an expert panel session, where selected members of the audience were asked to reflect on learning from the day, sparking a lively debate. Delegates were invited to ask questions and challenge the speakers throughout. There were opportunities for networking during the breaks and they were also encouraged to join in the discussion on Twitter using the hashtag #switchonclnr.

The slides presented on the day have been cut together with videos of the speaker sessions and uploaded to the CLNR YouTube site here to enable the learning to be easily shared and disseminated after the event. An event highlights video was also produced and shared with internal and external audiences

Event Feedback

In order to better understand the outcomes of the event and to inform future event planning, delegates were given two opportunities to provide valuable feedback.

1. On the day delegates were provided with qualitative evaluation forms that asked specific questions about the individual presentations. Only 9 delegates chose to complete and submit their forms on the day. However, their feedback was very positive, with a number of delegates commenting that they now had a better understanding of the size and scope of the project and all respondents rating the event 4 out of 5 or higher. Many delegates also took the opportunity to share their thoughts and insights on Twitter using the hashtag #switchonclnr

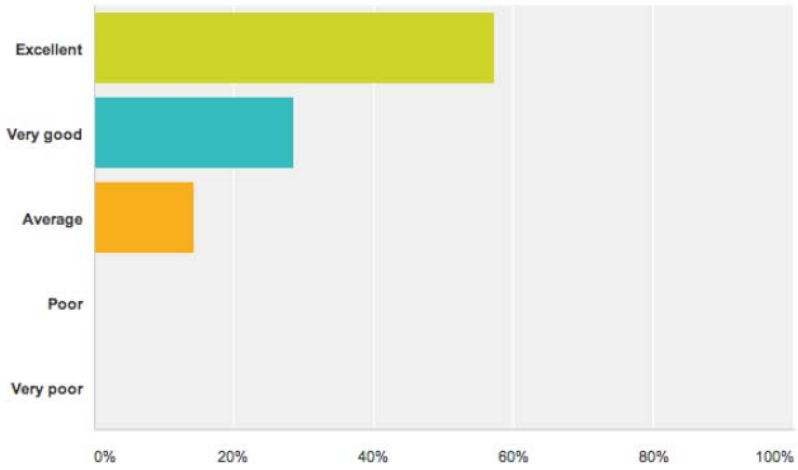
2. After the event delegates were sent an email with a link to the slide sets presented on the day and asked to complete a short online survey. Although the respondent rate was low, feedback was again positive with those who answered the questionnaire indicating that the event had significantly increased their understanding of the project. The results from the survey are included below.

Overall, the feedback received demonstrates the event was successful in what it set out to achieve. The high number of attendees and the diverse range of organisations present ensured a range of topics were discussed and interesting insights gained. The feedback also suggests that respondents found the event interesting and worthwhile and that they will be engaging with the CLNR agenda in the future.

Responses to the online survey

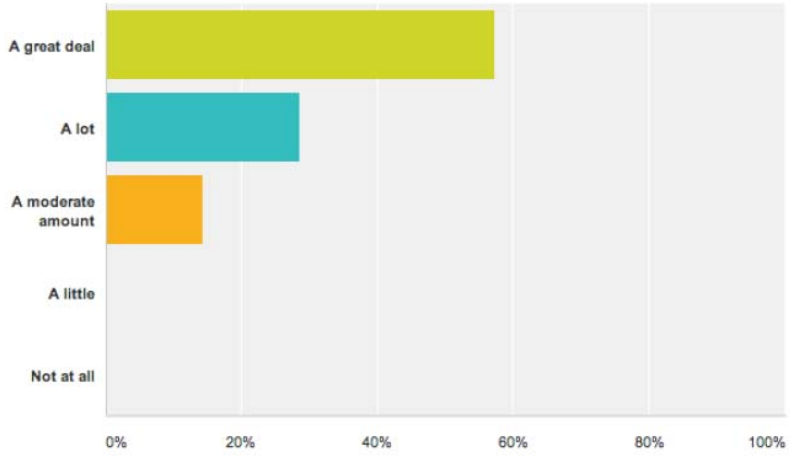
Overall, how would you rate the CLNR event?

Answered: 7 Skipped: 0



To what extent did the event improve your overall understanding of the CLNR project?

Answered: 7 Skipped: 0



What did you like about the event?

Answered: 7 Skipped: 0

Responses (7) | Text Analysis | My Categories

Categorize as... | Filter by Category | Search responses

Showing 7 responses

The organisation and planning
10/9/2013 9:47 AM View respondent's answers

Different speakers giving different perspectives. Relaxed and friendly environment. Good venue.
10/8/2013 1:40 PM View respondent's answers

Informailty, good crowd
10/8/2013 12:56 PM View respondent's answers

Variety of speakers, competency of speakers. all pitched at correct level. Seemed efficient and well run, with the right amount of time allowed for networking
10/8/2013 12:40 PM View respondent's answers

Good mix of speakers from supplier, DNO and academic community.
10/8/2013 12:39 PM View respondent's answers

The talks got batter as the day went on. i like the ones near the end best as most interesting
10/8/2013 11:55 AM View respondent's answers

Lots of figures used as well as good insight into the engagement process
10/8/2013 11:53 AM View respondent's answers

What did you dislike about the event?

Answered: 4 Skipped: 3

Responses (4) | Text Analysis | My Categories

Categorize as... | Filter by Category | Search responses

Showing 4 responses

Not much coverage of the alternative arguments or negatives
10/9/2013 9:47 AM View respondent's answers

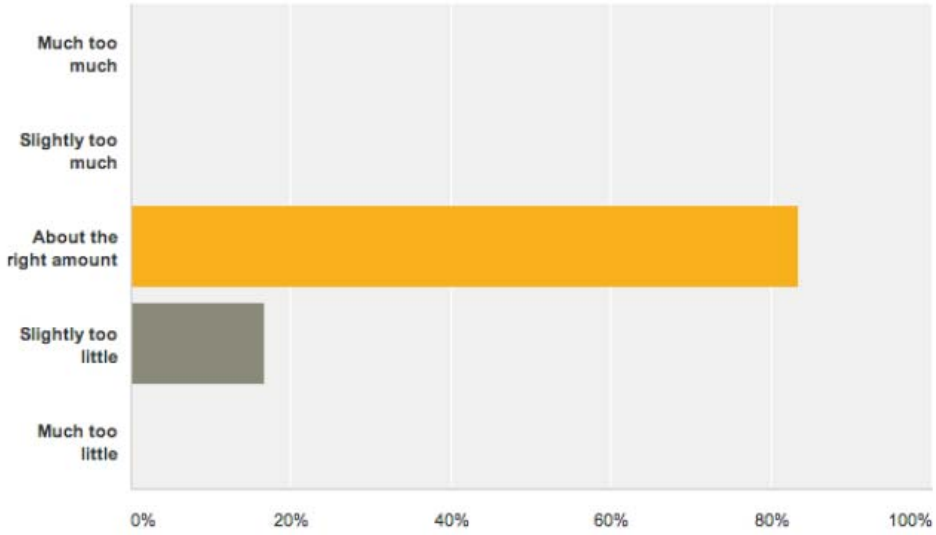
occasionally repetitive
10/8/2013 12:56 PM View respondent's answers

Could have had someone from Ofgem/DECC contribute
10/8/2013 12:40 PM View respondent's answers

I thought BG didn't share very much learning; it was more a list of installs and spend. This is typical of a big corporation, and i have had that role in my time.
10/8/2013 11:55 AM View respondent's answers

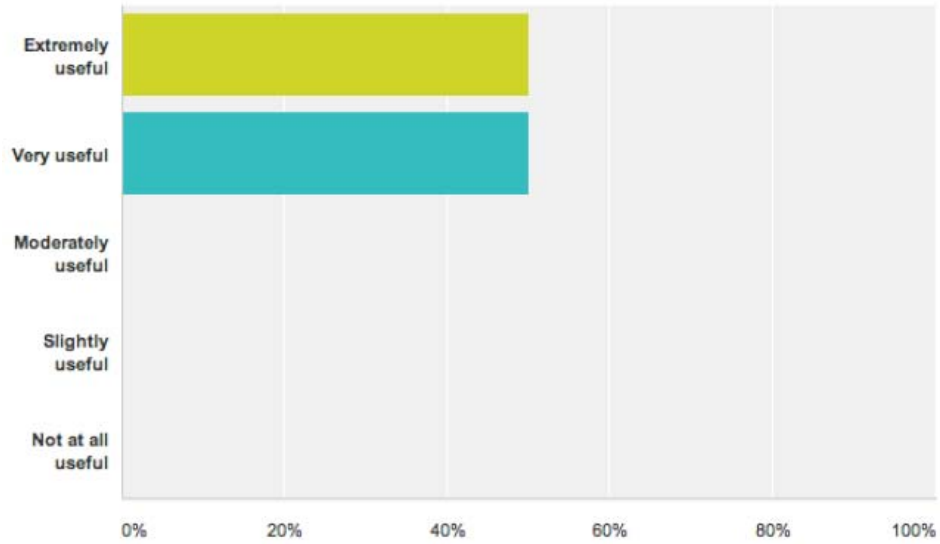
Was enough time allowed for the discussion and to ask questions?

Answered: 6 Skipped: 1



Overall how useful did you find the event?

Answered: 6 Skipped: 1



Customer-Led Network Revolution

Agenda

Customer Trials Knowledge Sharing Event, 1st October 2013

09.00 – 09.30	**Registration** Refreshments will be served on arrival
09.30 – 09.35	**Introduction and general housekeeping**
09.35 – 09.50	**Why CLNR matters** **Phil Jones, Chief Executive, Northern Powergrid** What the project means for Northern Powergrid and GB consumers
09.50 – 10.05	**How CLNR is delivering** **Jim Cardwell, Head of Regulation & Strategy, Northern Powergrid** Project overview, progress and outlook
10.05 – 11.00	**Why 12,000 customers joined the revolution** **Stavros Sachinis, Project Manager, British Gas** • Latest learning from trials with thousands of domestic and business customers • Emerging attitudes towards domestic demand side response and smart technology • The UK smart meter roll out
11.00 – 11.15	**Refreshment break**
11.15 – 11.35	**Demand side response trials with industrial and commercial customers** **Chris Thompson, LCNF Programme Manager, Northern Powergrid** • Results from the 2011 – 2012 trials • Looking forward to 2013 – 2014 trials
11.35 – 12.30	**Engaging consumers in the smart grid** **Professor Harriet Bulkeley, Durham University** • The approach and methodology to deliver the project's qualitative learning • Factors affecting energy usage and consumption • Understanding customer flexibility and behaviour
12.30 – 12.45	**Q&A session**
12.45 – 13.30	**Lunch**
13.30 – 14.10	**Emerging conclusions from the quantitative data** **Professor Phil Taylor, Newcastle University** • Overview of the data gathered to date; analysis, data and outputs • Load and generation profiles; early analysis and impact on future policy
14.10 – 14.30	**Development of practical project outputs** **Mark Drye, Director of Asset Management, Northern Powergrid** • Key DNO project outputs and the impact on business planning
14.30 – 14.45	**Refreshment break**
14.45 – 15.30	**Expert panel session** An opportunity to reflect on the learning from the day and ask questions of an expert panel of industry peers with an interest in the CLNR project
15.30 – 15.45	**Outlook and conclusions** **Jim Cardwell, Head of Regulation & Strategy, Northern Powergrid**
15.45	**Close**

Follow us on Twitter @CLNDUK

Customer-Led Network Revolution

Feedback Form

Customer Trials Knowledge Sharing Event, 1st October 2013

Your Name & Organisation

Why CLNR matters - Phil Jones, Northern Powergrid

1. What new and useful insights did you gain?

2. Was there anything you would want to challenge or disagree with?

How CLNR is delivering – Jim Cardwell, Northern Powergrid

1. What new and useful insights did you gain?

2. Was there anything you would want to challenge or disagree with?

Why 12,000 customers joined the revolution – Stavros Sachinis, British Gas

1. What new and useful insights did you gain?

2. Was there anything you would want to challenge or disagree with?

Images and commentary from the day

Rochelle Harrison @Rochelle_Energy 2 Oct
Observation from #switchonCLNR data is always key as we'll need new settlement profiles specific to LCTs not just credit or E7 in property
Retweeted by CLNR
Expand Reply Retweeted Favorite More

Emma Jones @ecjones 1 Oct
@CLNRUK Time of use household trial achieved 10% peak reduction, 3% overall #switchoncInr #smartmeter
Retweeted by CLNR
Collapse Reply Retweeted Favorite More

Liz Lainé @TreadingLightly 1 Oct
#DSR has long lead-in times - kit, comms, T&Cs. Learn lessons from #greendeal - set expectations & have clear consumer offer #switchonCLNR
Retweeted by CLNR
Expand Reply Retweeted Favorite More

Jim Oswald @spiralos 1 Oct
I have to say I am very impressed with the team trialling new low voltage grid technologies we have heard from today #switchonCLNR
Retweeted by CLNR
Expand Reply Retweeted Favorite More

CLNR @CLNRUK 1 Oct
Prof Phil Taylor @rolyatlihp looks at emerging conclusions from the project's quantitative data #switchonCLNR
pic.twitter.com/xGJahyl1dA
View photo Reply Delete Favorite More

Hezlin @hezlin_ab 1 Oct
@CLNRUK @rolyatlihp great talk!
Retweeted by CLNR
Hide conversation Reply Retweeted Favorited More

1 RETWEET 1 FAVORITE

Appendix 4: LO1 & LO2 trials – specification and participation in each test cell

Trial design				Number of trial participants			
Test cell	**Customer type**	**Load**	**Intervention**	**Gross target (bid)**	**Net target**	**Maximum**	**Current ie after drop-out**
1a	Domestic	General	None	9,000	6,000	8,909	8,377
1b	SME	General	None	2,250	1,500	2,250	2,250
2a	Domestic	General	None	600	400	161	157
HW		General, with electric hot water immersion heating				150	133
HW+SH		General, with electric hot water immersion heating & storage heating				71	65
2b	SME	General	None	150	100	81	81
3	Domestic	Heat pump	None	600	400	340	322
4	Domestic	MicroCHP	None	20		13	12
5	Domestic	PV	None	150	100	160	152
6	Domestic	Electric vehicle	None	150	100	159	159
7	I&C	CDCM[9]	None	14,000	analysis of pre-existing dataset		17,639
8	DG	DG	None	230	150	160	160
9a	Domestic	Regular	time of use	600	400	680	611
9b	SME	Regular	time of use	150	100	44	44
10a	Domestic	Regular	restricted hours	600	400	54	54
10b	SME	Regular	restricted hours	150	100	3	3
11a	Domestic	Regular	direct control	600	400	97	97
12	Domestic	Heat pump	time of use	600	400	17	17
13	Domestic	Heat pump	restricted hours	150	100	0	0
14	Domestic	Heat pump	direct control	150	100	17	17
18a	I&C	Responsive load	DSR for ancillary services (fast reserve)	5	proof of concept	2	2
18b	DG	Responsive generation		5		12	12
19	DG	Responsive generation	DSR for ancillary services (voltage support)	5		1	1
20	Domestic	PV	automatic within premises balancing	600	400	99	99

[9] Common distribution charging methodology

Trial design				Number of trial participants			
Test cell	**Customer type**	**Load**	**Intervention**	**Gross target (bid)**	**Net target**	**Maximum**	**Current ie after drop-out**
			manual within premises balancing			160	150

N.B. 28 of the domestic customers taking part in a range of trials (heat pump, PV, electric vehicle, microCHP and general load customers) will also have power quality monitoring equipment, with 17 installed already.