Project Progress Report 4

Project Name:	Customer-Led Network Revolution (CLNR) Project		
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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 fourth formal progress report sets out how the project is on track to deliver 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. In particular, we believe the sociotechnical learning on the integration of different technologies with an understanding of the potential for customer flexibility is shaping up well to break new ground in smart grid development.

1.2 The June to November 2012 period was characterised by a continued broad range of activity enrolling trial participants, installing customer equipment, installing network technology and analysing data from the existing data collected. Highlights have included:

- Customers numbers in the monitoring trials exceed 12,000 and we have active participation in flexibility trials from over 900 customers;
- The residential time-of-use trial commenced in April 2012 and it remains attractive to customers with a relatively low drop-out rate of just over 6% over the first eight months;
- Continuing engagement with solar photovoltaic customers continues to demonstrate the customers' appetite for understanding and managing their energy use;
- In contrast, small and medium enterprises (SME) customers have shown a general level of inflexibility to adapt their electricity use at times to suit the power grid, demonstrating that our restricted hours or direct control propositions are inappropriate for this group of customers;
- With support funding from the £2.8m Department of Energy and Climate Change (DECC) grant, there are now over 400 heat pumps installed, of which ca. 20 also have a thermal store in order to trial smoothing of the power usage over the network peak period while maintaining comfort levels (the innovative control system has been recognised with a national award);
- The vast majority (over 95%) of our heat pump trial participants are customers of registered social landlords providing new learning in terms of engaging with these customers who may not have personally chosen to adopt their low-carbon technology;
- New routes established to secure electric vehicle trial participants by joining with other trials or charging infrastructure initiatives;
- Analysis of 12 month's data for ca. 4,800 smart meter customers has been completed, the information has been shared at conferences and we are on track to deliver the key next learning output of customer profiles in December 2012;
- Almost 900 residential and SME customers have taken part in surveys and a further 150 in more detailed in-depth social interviews creating a significant and growing body of evidence on energy practices;

- Trial participants who use electricity to heat water are now on a monitoring trial as opposed to a restricted hours tariff since during enrolment it was found that almost all of them are already participating in an off peak tariff such as Economy 7;
- A study of the potential for demand-side response (DSR) amongst industrial and commercial (I&C) customers has been completed by Flexitricity;
- A range of network technology has been installed at all voltage levels to enable trials to test the use of real-time thermal rating and enhanced automatic voltage control (electrical energy storage has been delayed);
- The grand unified scheme (GUS) control system is now installed with monitoring data from field nodes being successfully received by the central server and installation of the remote distribution controllers in progress; and
- The process by which the results of the project's real customer and network trials will be applied on a wider scale has been developed by Durham Energy Institute – the VEEEG methodology (validation, extension, extrapolation, enhancement, generalisation).

1.3 In summary, the project remains on track to deliver significant learning that is relevant, timely and valuable. As in previous reporting periods, the route to achieving this learning continues to be adapted to suit the dynamic nature of the operating environment and the externalities that have differed from our original planning assumptions. This report contains specific examples from the customer enrolment activity or from the procurement of innovative emerging technology that has required us to change our plans.

1.4 On the customer trials, the majority of the customer enrolment is now complete over the range of 22 individual test cells. Good progress has been made on recruitment with many of our trial propositions being attractive to customers and learning also generated in situations where propositions proved to be inappropriate. The prime exception is for electric vehicles where the new approaches to secure customers have been largely agreed with Charge Your Car but not yet fully implemented and numbers therefore remain low at present. Elsewhere, the activity now mostly involves installing trial monitoring or control equipment. There has been a significant upturn in the number of heat pump installations and customers joining the trial. Significantly, there are around 20 heat pump installations with thermal stores that allow power supplies to be flexed. Installation is in progress for the residential disaggregated monitoring trials. The equipment installation is relatively complex and intrusive, so we have recruited 'friendly' trial participants from staff in the project partner organisations to ensure that valuable learning may be achieved on these trial installations to ensure a smooth installation experience for the remaining customers. The electrically heated water trials have been redesigned and enhanced to better suit participating customers. The project is now focusing on studying usage profiles and the use of the 'boost' facility in peak periods. This is intended to plug a knowledge gap relating to the electricity usage and practices of today's Economy 7 customers.

1.5 As with residential customers, a significant number of SME customers were attracted to the time of use tariff offering, with the target participant numbers being achieved very quickly. However, during the subsequent assessment surveys it was found that there was little appetite for the restricted hours or direct control offerings, with customers generally unable to flex their operations in a way which would allow them to take advantage of such tariffs. As a result, we are not proceeding with these more intrusive SME customer

trials in any significant volume but we will be producing a valuable output to record the reasons why SME customers appear not to be able to provide the level of flexibility required by this trial.

1.6 Since the success of the industrial and commercial (I&C) demand-side response (DSR) trials undertaken in the winter of 2011/12, described in the previous report, the project has carried out additional research into the market for DSR contracts in preparation for a second round of DSR trials in 2013. We are currently in the process of recruiting additional I&C participants, continuing to work with commercial aggregators.

1.7 The customer engagement plan and data protection strategy documents were further updated and re-approved by Ofgem in order to reflect the new approaches being taken to secure the participation of electric vehicle customers. Ofgem has also reviewed and commented on a further 15 individual items of customer correspondence in addition to the existing 59 pieces of approved material.

1.8 The network technologies installed and commissioned include substation monitoring, real-time thermal rating systems (for HV and EHV overhead lines and LV underground cables) and LV enhanced automatic voltage control. This monitoring equipment is performing well and is providing interesting data. In some locations we now have a one-year baseline of data and this has already been used to inform learning in a number of Durham Energy Institute academic papers. Delays to installation have been experienced in two key areas. A123 Systems Inc., the supplier of the electrical energy storage systems, entered Chapter 11 bankruptcy protection proceedings in the US and, whilst we are confident that we will receive the batteries, the associated disruption to the supply chain means that the supply of our six units has been delayed until quarter one 2013. Further, there has been a delay to the supply of secondary transformers with on-load tap changers, which means that the completion of the voltage control technology is now forecast to complete in quarter one 2013.

1.9 The grand unified scheme (GUS) control system central installation is now complete with work forecast to continue to June 2013 to connect to all the remote devices. This completion date has been adversely affected by the network technology delays. A detailed plan has been created to understand how the GUS control system will be used to deliver the network trials devised by Durham Energy Institute. The full list of potential trials has been rationalised in order to determine the appropriate sequence to deliver the required learning. The VEEEG (validation, extension, extrapolation, enhancement, generalisation) methodology allows the results of the project's real customer and network trials to be applied on a wider scale and utilised to model a much greater range of combinations than can be practically trialled. This makes the results of the project relevant to different future scenarios and to a wide range of networks.

1.10 The solutions development work to transfer project learning into business as usual activities continues to make good progress and recent work has centred on the completion of gap analysis work with existing network policies and procedures and development of the Network Planning and Design Decision Support (NPADDS) tool. NPADDS is being developed to represent trial network areas to identify voltage, thermal and earth loop impedance constraints, in relation to novel solutions being trialled on the project.

1.11 Communications and dissemination output for the project has ramped up in the past six months to match the learning being delivered. The events included the CLNR distributor

review, the Energy Networks Association Low Carbon Networks (LCN) Fund conference and presentation of academic papers at a number of prestigious international conferences. The LCN Fund conference in Cardiff saw the launch of the CLNR Network model, which provides a hands-on demonstration of the logic behind the interventions being trialled. A CLNR LinkedIn group was established in November 2012, with a growing, relevant and interactive membership of over 100 to date.

1.12 In order to maximise the value of customers' investment in LCN Fund activity, CLNR has been actively engaging with other projects. In addition to a continuing dialogue with Low Carbon London, the project has also entered into a collaborative project partnership with the LCN Fund Tier 2 I^2EV project, led by Scottish and Southern Energy and managed and delivered by EA Technology.

1.13 The current detailed project plan continues to show some activities extending beyond the project end date in December 2013. The previous plan showed some of the customer-trial learning extending into 2014. This was to take account of the customer scarcity issues for heat pumps and electric vehicles in particular which have delayed the start of the trials. The delays experienced in the supply chain for the network technology are almost certain to cause this part of the project to also extend into 2014. A plan review, currently on going, will confirm this situation. We are evaluating a proposal to deliver the bulk of the learning as intended in 2013 with a follow-up addendum report in 2014; as originally proposed for some of the customer trials. Following the plan review, we expect this to be discussed with Ofgem in quarter one 2013.

1.14 We are not forecasting any cost variances to the total project spend of £31.0m.

1.15 There have not been any significant changes in the risk profile for the project since the last report and the top five risks have remained the same. The key project risks continue to be associated with the application of innovative network technology, the availability of sufficient customers to deliver the required learning from the trials and the limited attractiveness of the trial propositions with consequent risks to trial recruitment. For the network technology, the key risks relate to the availability of the novel technical solutions in the timescales required. For the customer-facing trials we have already deployed the alternative route to overcome the shortage of customers with air-source heat pumps (ASHPs) and the electric vehicles (EVs) customers are in the process of being sourced by another route.

1.16 The following table sets out the key project events that took place in the reporting period.

Key project events

Date	Event
11 June 2012	First Baxi Ecogen micro-CHP installation
25 June 2012	First 'smart' heat pump installed
03 July 2012	First heat pump monitoring installation
06 July 2012	First solar PV automatic within-premises balancing installation
12 July 2012	CLNR Distributor Review event held at Durham University

Date	Event
08 August 2012	Indesit Company 'smart' washing machine delivered for technical testing
28 August 2012	First micro-CHP monitoring installation
10 September 2012	First electric hot water and storage heating monitoring installation
11 September 2012	First SME restricted hours installation
15 September 2012	First SME enhanced monitoring installation
10 October 2012	CIGRE RSEEC 2012. Two papers presented: • Use of Battery Storage to Increase Network Reliability under Faulted Conditions • Use of Real-Time Thermal Ratings to Increase Network Reliability under Faulted Conditions
11 October 2012	Heat pump controls wins Micropower Council 'Innovation of the Year' award
14 October 2012	IEEE PES ISGT Europe 2012. Two papers: • An Interdisciplinary Method to Demand Side Participation for Deferring Distribution Network Reinforcement • Distribution Network Voltage Control Using Energy Storage and Demand-Side Response
16 October 2012	A123 Systems files for bankruptcy
17 October 2012	First enhanced circuit and appliance monitoring installation
26 October 2012	Successful factory acceptance testing of central GUS control system
26 October 2012	Installed underground cable real-time thermal rating system
14 November 2012	Royal Melbourne Institute of Technology (RMIT). One paper presented: • Beyond Behaviour Change: Systems of electricity provision and the constitution of 'smart' energy practices
16 November 2012	First heat pump customer on time of use trial
21 November 2012	400th DECC-subsidised heat pump installed
28 November 2012	Successful connection to smart heat pump via GreenCom smart grid platform

2 Project Manager's Report

Learning Outcomes 1 and 2 – (LO1) Existing and Future Load
(LO2) Customer Flexibility

Activities completed in this reporting period

2.1 We have substantively completed the customer recruitment and enrolment phase for the 22 residential and SME business customer trials, except in the particular areas of scarcity, namely, electric vehicles (EV) and heat pumps (HP). We have experienced high take-up rates for PV propositions (11%) and Time of Use (ToU) propositions (8%). The test cell data that is referred to throughout this section is detailed in Appendix 5.

2.2 Our plans for undertaking extensive disaggregated monitoring trials of domestic customers have gained significant ground. In this we adopted a strategy of utilising willing "friendly" employees from partner organisations to make up the required number of 150 participants. The technology to provide a detailed breakdown of electricity usage in the home at both a circuit and appliance level has been trialled in earnest on a pilot of 10 of these participants and is set for full rollout to the remaining 140 by January 2013.

2.3 Installation of the DECC-funded heat pumps, including the award-winning thermal storage version, has progressed well during the period with over 400 basic units and 17 thermal-storage units now installed in customers' homes. The installation of monitoring equipment on these units has been challenging and the numbers of units with monitoring equipment in situ lags significantly the number of installed units at just under 80 in total. There are however mitigation plans in place to rectify the situation and the monitoring rollout for heat-pump units is set to complete by the end of quarter 1, 2013.

2.4 We have secured a group of customer participants for our micro-CHP trials via both existing sales routes and via "friendlies" in partner organisations. This means that we now have enough participants to run our small-scale monitoring trial in respect of this technology.

2.5 For both the base monitoring and the automatic and manual within premises balancing aspects of our photovoltaic (PV) trials, there has been successful recruitment of substantial numbers of customers to participate in the trial. This may be attributed to two main factors; the availability of this customer type within the region, and the willingness of those who already have this photovoltaic cells to make better use of its generation output and/or the opportunity to realise cost efficiencies.

2.6 The opportunity to collaborate with customers of Charge Your Car (North) is a route to address the scarcity of EV customers by offering incentives on fully-funded EV charge points. Significantly, approval from the Authority has been secured for the latest version of the customer engagement plan and data protection strategy mandatory documents. These have also been amended to include customers recruited in partnership with Charge Your Car.

2.7 The high level of interest from residential customers in time of use tariffs has meant that the time of use aspect of our trial is now oversubscribed. We currently have a total of 683 customers who have chosen to adopt this tariff and who are currently having their electricity consumption monitored. The insight gained through the recruitment process here is contrary to the current perception that consumers require fewer options and reduced complexity in the tariffs system.

2.8 The aspect of the trial to develop a baseline understanding of customers' electricity usage patterns on the existing Economy 7 tariff is under development. This tariff uses electricity

to heat water and/or for storage heating. Monitoring of these customers' electricity usage will commence early in December 2012 and is intended to plug a current knowledge gap relating to Economy 7 customers' electricity usage and practices.

2.9 Recruitment of SME business customers to the restricted hours and direct control trials has revealed a definite lack of appetite for such propositions in that sector. 270 customers were initially attracted to this proposition but during the technical assessment and survey phase, the customers subsequently felt unable to adapt their business to submit to the levels of business disruption required by these propositions. This has resulted in zero participation in our direct control trial for SME customers and only two SME customers participating in our restricted hours trial.

2.10 Durham Energy Institute has undertaken analysis of around 4,800 residential smart meter data records. These were collected over the 12-month period from May 2011 to May 2012 and split by demographic sub-group. In addition to this, analysis of seasonal data for the extreme winter period in December 2010 has also been undertaken.

2.11 Web-based surveys have been deployed to almost 1,000 residential and SME business customers and in-depth face-to-face qualitative social interviews have been carried out by Durham Energy Institute for 150 residential and SME business customers.

2.12 Following the industrial and commercial (I&C) trials during January and February 2012 work has continued with ESP Response, Flexitricity and KiWi Power to source approximately twelve customers for the summer 2013 DSR trials. The customer acquisition process has targeted both new customers in specific areas of the network that are forecast to exceed firm capacity in the next 10 years and also customers from the aggregators' existing portfolios. The 2nd tranche of I&C trials will provide the opportunity to test new contract structures, a larger portfolio of demand side response contracts, a geographically targeted customer acquisition process and enhanced communication systems. The objective for the enhanced communication process is to interface the grand unified scheme (GUS control scheme) with the aggregators' systems which will automate the demand side instruction process.

2.13 In addition to the specific requirement to execute DSR contracts with I&C customers, Flexitricity was engaged to analyse the market potential for I&C DSR by approaching all I&C customers fed from six targeted primary substations to:

- assess their knowledge of demand side response (DSR);
- establish their willingness and capability to participate in DSR programmes; and
- identify barriers to demand response programmes.

Denwick and Rise Carr were selected as these are the principal test networks for the CLNR project; the other four were selected as they are nearing firm capacity and therefore DSR could be a real alternative to network reinforcement. The standard aggregator commercial engagement methodology was employed and each stage of the customer journey was recorded. The contract engagement included existing DSR programmes (e.g. STOR) and CLNR requirements.

At a glance: I&C DSR survey statistics

A total of 509 calls were made over the survey period

152 sites (182 MPANs) were targeted across the six primary areas

Contact with 78 sites was cancelled due to a variety of reasons e.g. No names policy, business closed, the correct person in the business could not be located, no answer to calls etc.

44 sites where the decision maker contact (DMC) was identified but further progress was unsuccessful as the DMC was unavailable for further discussions

30 sites where the DMC was contacted. Of the 30, 13 completed a fact find survey, 3 completed a full survey, 7 were not interested and 7 were referred to another contact

9 sites from the original list of 152 sites remain interested in participating in future DSR programmes; some of these sites may be available for the CLNR I&C summer 2013 trials

Activities planned for the next reporting period

2.14 Activity for the coming reporting period will close out a number of key trial milestones and address some issues that have arisen over the last period in relation to recruitment and installation. In particular:

- The customer-facing documentation relating to the wet white goods (WWG) trials will be completed, along with recruitment of trial participants into the remaining residential and SME business customer trials;
- Monitoring of installations of those customers already recruited will be completed, including close-out of the scarce HP, EV and WWG trials;
- The opportunity for EV customer recruitment, with either Charge Your Car or directly with Nissan through the I^2EV project will be closed out;
- Recruitment will be completed and equipment installed for around 35 residential customers to measure power quality in relation to low carbon technology installations;
- A key achievement will be the closing of the technical solution with Indesit Company and the DSR hub by the end of Q1, 2013. This solution included direct control trials and installations of load-controllable washing machines functioning under the residential restricted hours trial.

2.15 The survey work in the next reporting period will see completion of the web-based survey participation work and analysis of the results. The remaining in-depth face to face qualitative social interviews will be completed, findings concluded and first pass of quantitative data matched to these customers.

2.16 The balance of residential smart meter data up to the total 8,909 will be analysed, plus analysis undertaken of the 2,250 SME business smart meter data.

2.17 A customer recruitment appraisal and lessons learned report for both residential and SME business customer recruitment will be completed by Sustainability First.

2.18 The customer demand and generation profiles, by both customer type and low carbon technology (LCT) type will be published by the end of December 2012.

2.19 The customer demand and generation profiles, before and after a range of intervention types, will be published by the end of April 2013.

The focus for the I&C DSR summer 2013 trials

The I&C DSR trials have been rescheduled from the winter 2012/13 period to the summer of 2013. The amended trial plan will expand the customer acquisition window which will deliver additional learning for the project and will ensure the trials are fully synchronised with the installation of network technology and GUS. The revised plan includes the following activity:

- Execute contracts with around 10 customers with three aggregators;
- Design new contract structures building on the experience from the first tranche of I&C DSR trials;
- Test the enhanced communication processes between GUS and the aggregators;
- Investigate the opportunity to contract directly with a large I&C consumer;
- Further investigate the issues associated with targeting specific geographic areas for the provision of DSR from customers new to these schemes.

Learning Outcome 3 – Network Flexibility

Activities completed in this reporting period

2.19 The configuration and installation of the GUS centralised and distributed control system has commenced:

- Factory acceptance tests and installation tests of GUS for the core control system at the Northern Powergrid control room have been completed;
- Installation of the Siemens Remote Distribution Controllers (RDC) has commenced at many of the test cell locations which forms the distributed hub of the GUS architecture;
- Installation and commissioning of the entire substation monitoring equipment across the selected test cells has been successfully completed.

2.20 The iHost data server has been successfully installed at the Northern Powergrid control room, which receives all the monitored data from the network field nodes.

2.21 The overhead line high voltage and extra high voltage real-time thermal rating (RTTR) systems have been successfully installed and commissioned. Further achievements included:

- Installation and commissioning of all intelligent low voltage link boxes across all test cells;
- Completion of the development, build, installation and commissioning of the low voltage underground cable real-time thermal rating systems on the Rise Carr network;
- Development of an additional test cell (24) to understand the impact of heat pumps on the network to cater for the lack of uptake in test cell 14, inclusive of EAVC (Enhanced Automatic Voltage Control) and RTTR;
- Commencement of the installation and commissioning of the primary transformer thermal rating monitoring equipment at Rise Carr and Denwick.

2.22 The EAVC low voltage mains regulator has been successfully installed and commissioned on the heat pump test cell at Hexham. Other progress includes:

- Commenced EAVC deployment and installation on the 20kV regulator sites at Glanton and Hepburn Bell;
- Commenced EAVC deployment and installation on our 20kV switch capacitor site at Hedgeley Moor;
- Commenced EAVC deployment and installation on the primary site at Rise Carr;
- Commenced EAVC deployment and installation on our on our primary site at Denwick which is in conjunction with a new 66kV incoming network reconfiguration to accommodate two wind farms at Wandylaw and Middlemoor.

2.23 Site and civil works have been completed, ready for battery installations, at Rise Carr primary substation, High Northgate, Harrowgate Hill and Wooler Ramsay substations. Wayleave agreements have been completed, as well as site and civil works at the new network location on the Mortimer road network ready for battery installations. Site and civil and enabling works have been completed at:

- Darlington Melrose substation ready for EAVC transformer replacement, including the GRP transformer housing and control equipment;
- Wooler Bridge substation ready for EAVC transformer and associated switchgear replacement;
- Mortimer road substation ready for EAVC transformer and associated switchgear replacement including the anti-vandal steel substation housing.

2.24 The arrangements have been finalised for the construction and testing of the secondary transformers with on load tap changers. Shipping will take place over the Christmas Period for January 2013 installation.

2.25 Issues have been managed arising from the business restructuring of the Electrical Energy Storage (EES) supplier A123 Systems Inc. when they entered into Chapter 11 bankruptcy protection in October 2012. Business relations have been maintained and contract terms modified to enable completion of system manufacture and shipping. Units are forecast to be delivered in quarter 1, 2013 with commissioning of the largest 2.5MW unit at Rise Carr in March 2013, with all other units arriving and installing earlier.

Activities planned for the next reporting period

2.26 Two key installation and commissioning activities will take place in the next reporting period, namely the enhancement of the GUS core control system functionality, including development of the DSR and EES applications. Secondly, the installation and commissioning of the A123 batteries will be completed and their interface with the GUS control system commissioned. Other installation and commissioning activities will include:

- Identification and completion of the installation of primary transformer thermal rating equipment in relation to the industrial and commercial test cells of LO2 (TC18 and 19), in conjunction with developing the contracts with commercial aggregators;
- Completion of the development, build, installation and commissioning of the high and extra high voltage underground cable real time thermal rating systems on the Rise Carr network;

- Completion of the installation of the Remote Distribution Controllers (RDC) at all the test cell locations;
- Installation and commissioning of the transformer with on-load tapchangers and commissioning of their interface with the GUS control system;
- Progression of the holistic GUS system to incorporate the flexible data warehouse;
- Commissioning of the primary transformer thermal rating monitoring equipment at Rise Carr and Denwick;
- EAVC deployment and commissioning on the high voltage 20kV regulator sites at Glanton and Hepburn Bell;
- EAVC deployment and commissioning on the high voltage 20kV switch capacitor site at Hedgeley Moor;
- EAVC deployment and commissioning on the Primary site at Rise Carr;
- EAVC deployment and commissioning on the Primary site at Denwick in conjunction with the network reconfiguration to accommodate the two wind farms.

2.27 The schedule of collaborative network trials created by Northern Powergrid and Durham Energy Institute will commence with autonomous network trials of the standalone new network technologies. Network monitoring will be enhanced to further augment the detail of power quality monitoring within premises in test cell 3 of LO2 in the South Shields Hillcrest distribution area. Finally, a communication relay will be developed between the pole mounted auto reclosers to feed remote analogue feeder load data back to the GUS processor, to further enhance the accuracy and determination of its Volt VAr control algorithms.

Learning Outcome 4 – Optimum Solution

Activities completed in this reporting period

2.28 Durham Energy Institute (DEI) has continued to design its VEEEG methodology for the post-trial network analysis. The approach by DEI takes into account five phases of data handling to identify the optimum solution in learning outcome 4, which will:

- Validate trial networks and component models with results from field trials.
- Extend field trials by simulating longer duration trials, simulating/emulating any missing trials and trials which are not feasible as part of trial programme.
- Extrapolate results from the network flexibility field trials by moving the locations and increasing the penetrations of LCTs, to evaluate the headroom for future scenarios of the trial networks.
- Enhance trial results by simulating/emulating new locations, sizes and combinations of network and customer interventions.
- Generalise the results from the trial networks to collect most valuable learning.

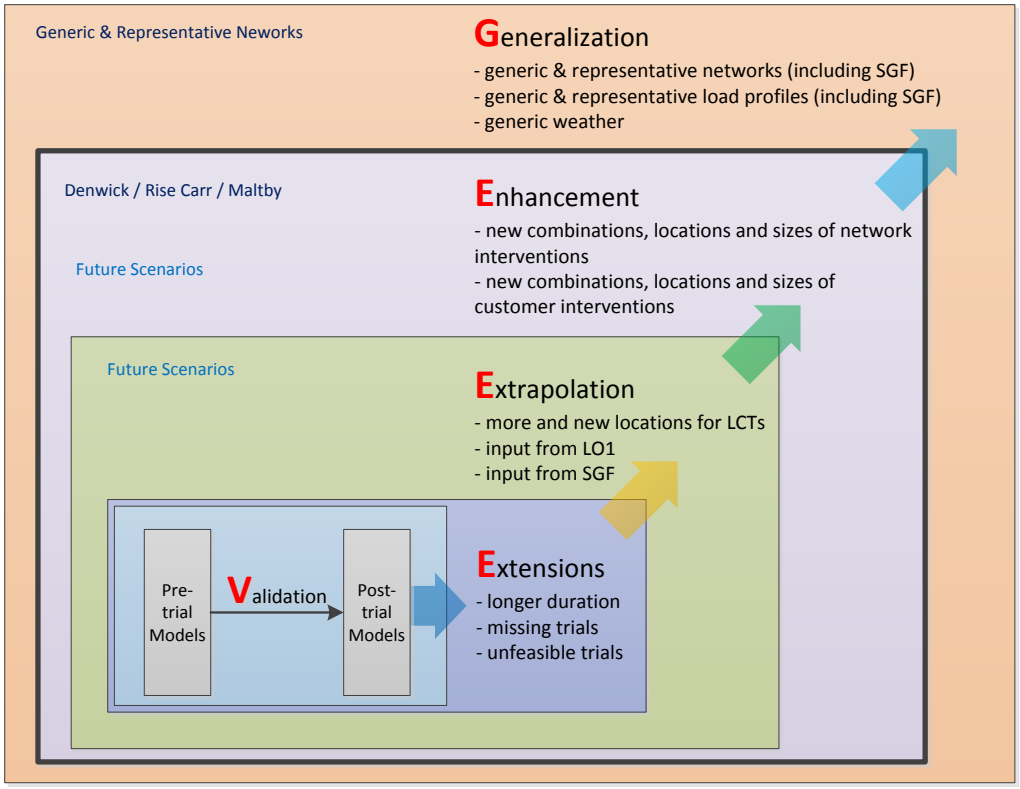


Figure 1: VEEEG Methodology

2.29 A VEEEG planning technical note has been completed. This outlines the process and describes in detail the work associated with each phase of the VEEEG methodology being undertaken by DEI. The first draft technical note has also been completed by DEI. This is an initial example of the application of the VEEEG methodology with CLNR pre-trial analysis of autonomous, single and grand unified scheme (GUS) voltage control trials at Denwick. The draft technical note used the models of Denwick HV network, Wooler Bridge LV network and Wooler St Mary LV network, to evaluate the capability of these networks to accommodate low carbon technologies, following deployment of enhanced automatic voltage control and electrical energy storage. Durham used validated network models and a combination of real and synthesised load and generation data. Load profiles derived through analysis of smart meter measurements, and LCT profiles derived from salient literature and real data from trials, have also been introduced and applied to the initial analysis work.

DEI academic publications resulting from the VEEEG methodology

Distribution Network Voltage Control Using Energy Storage and Demand-Side Response (IEEE PES ISGT Europe 2012).

Use of Battery Storage to Increase Network Reliability under Faulted Conditions (CIGRE RSEEC 2012).

Use of Real-Time Thermal Ratings to Increase Network Reliability under Faulted Conditions (CIGRE RSEEC 2012).

Customer-Led Network Revolution - Integrating renewable energy into LV networks using energy storage (CIRED LV workshop 2012).

Activities planned for the next reporting period – LO4

2.30 Durham Energy Institute will continue to draft technical reports as part of the application of the VEEEG methodology on the network flexibility field trials. The final output will be a group of reports that evaluate, using results from the VEEEG analysis methodology, solutions and groups of solutions using the evaluation criteria including headroom, network constraints, resilience and reliability, scalability and flexibility, communications requirements, network losses, cost and complexity.

Final technical reports to be produced as part of the application of the VEEEG methodology on the network flexibility field trials are as follows:

- Real-time thermal rating (RTTR);
- Electrical energy storage (EES);
- Demand-side response (DSR);
- Enhanced automatic voltage control (EAVC);
- Integrated power flow management;
- Integrated distribution network management.

2.31 Initial reports using the VEEEG methodology will be based on simulation, emulation and early customer and network flexibility field trial findings where possible. Finally, in the next reporting period, the refinement of the outputs required to support the prototype network planning and design decision support tool being developed by EA Technology, will be complete.

Learning Outcome 5 – Most Effective Delivery

Activities completed in this reporting period

2.32 EA Technology has completed pre-trial gap analysis work to baseline documentation sets in relation to novel solutions being trialled on the CLNR project, which included:

- Completion of a baseline policies and procedures report that identifies the generic document set for designing and operating low carbon networks in line with the CLNR trial of network control and monitoring equipment. The report took into account the asset lifecycle approach, and with support from senior users in Northern Powergrid, identified the generic documents sets and identified gaps in existing documents sets;
- Completion of pre-trial baseline training requirements report that considered the current training and knowledge delivery practices currently in place across the various Northern Powergrid business units and produced a matrix of requirements. The initial requirements work will feed into the post-trial learning phase following the learning generated from the introduction of novel network equipment being trialled on the CLNR project;
- Completion of a report to baseline operational procedures and safety rules. This report reviewed the effect the introduction of the novel technologies being trialled, could have on the distribution network operational procedures and safety rules. The novel technologies described in the report that are being trialled on the CLNR project include Demand-Side Response (DSR), Electrical Energy Storage (EES), Enhanced

Automatic Voltage Control (EAVC) and Real-Time Thermal Rating (RTTR);

- Completion of power quality assessment report that considers whether the Power Quality monitoring devices currently installed and proposed for installation are sufficient in number and correctly located to meet the aims of the learning. The report concludes that the majority of requirements are already adequately catered for; some issues have been highlighted and recommendations made for these locations.

2.33 EA Technology has commenced the specification and development phase of the Network Planning and Design Decisions Support tool (NPADDS). The key part of the specification phase has been to look at the integration and importing of data from current design tools and asset management information systems. Interaction with senior users such as system design and strategic planning have ensured that the approach gives consideration to the current working practices, but is also flexible enough to take into account planned integration of new business systems projects within Northern Powergrid. The development structure of NPADDS has been broken down into a number of software engines including assessment, solutions, compliance, and policy engines.

2.34 The prototype tool is being developed to identify voltage, thermal and earth loop constraints and will visually represent the trial network areas and give the design engineer a range of solutions to make appropriate assessments on the impact of smarter network technologies compared with conventional solutions. The learning from the network flexibility trials, including the amount of network headroom released and associated costs, will be incorporated into the NPADDS assessment tool.

2.35 EA Technology has commenced the initial specification phase work to develop and draft the policy guidance documentation for the application of Demand-Side Response (DSR) Electrical Energy Storage (EES), Enhanced Automatic Voltage Control (EAVC) and Real-Time Thermal Rating (RTTR).

2.36 EA Technology has commenced the initial specification work to produce a report on the instrumentation specifications that will be required to provide the additional monitoring thought necessary in both primary and secondary low carbon substations.

2.37 DEI has commenced the review and recommendations for commercial frameworks with initial baseline of existing commercial arrangements and emerging practices with senior users associated with network trading, market strategy, revenue and charges.

2.38 EA Technology has commenced the requirements capture phase and specification phase for recommendations to update ACE 49 and ACE 105. As part of the specification work between project partners viability has been established to repeat the ACE 49 methodology using smart meter data from the CLNR trials to compare with results from ACE49 in 1981.

Activities planned for the next reporting period

2.39 The NPADDS prototype development phase will continue by using representative data from the test cell areas to run assessments and prove the system. Continued on-going engagement and support from the senior users to design, specify and test the software development will be sought. EA Technology will be using, throughout the development phase, extracts of real network data and asset spatial data.

2.40 Further development of guidance documentation will take place as trial results from network technology start to inform recommendations for instrumentation specifications and asset specifications.

2.41 Commence detailed specification and design of training modules and e-learning package with senior users. The main deliverables will focus on the methods for knowledge transfer, identification of modules and user groups, development of training materials and transition into business as usual functions.

2.42 There will be a refinement of initial gap analysis based on trial results to develop draft generic GB distribution policy guidance for the application of novel technologies being trialled on the CLNR project including voltage control, ratings (lines, cables and transformers), real-time thermal ratings, electrical energy storage and demand side response.

2.43 A gap analysis of European and International standards activities relating to smart grid/sustainable network technologies will be produced. This assessment work will review the impact on technologies and ways of working being trialled in the CLNR project and inform how CLNR outputs may be best introduced into the European standards process.

2.44 The pre-trial phase of the commercial arrangements work will be initiated, which will look at the optimal commercial arrangements to support the transition to smarter network.

Communications and knowledge dissemination

Activities completed in this reporting period

2.45 The following communication 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.

1 June 2012	Publication	*Publication of CLNR tariffs development report
6 June 2012	Conference	Realisation of the Future Smart Grid
25 June 2012	Conference	Grid Scale Energy Storage
27 June 2012	Conference	European Demand Response and Dynamic Pricing
5 July 2012	Conference	Royal Geographical Society annual conference 2012
12 July 2012	Stakeholder event	*CLNR Distributor Project Review Meeting
23 August 2012	Media	Windpower Monthly publication
4 September 2012	Conference	Smart Grid Demonstrators: Forum and Tutorial (part of UPEC 2012)
6 September 2012	Other	"Fully Charged" episode on CLNR goes live (available on iTunes and YouTube)
6 September 2012	Stakeholder event	Energy Leadership Council (North East)
19 September 2012	Conference	IET Smart Grid Conference 2012 Energy storage systems in future low carbon electrical networks
1 October 2012	Publication	*CLNR working paper: social science overview
2 October 2012	Media	Radio Newcastle interview
10 October 2012	Conference	CIGRE RSEEC 2012 Use of Real-Time Thermal Ratings to Increase

		Network Reliability under Faulted Conditions Use of Battery Storage to Increase Network Reliability under Faulted Conditions
14 October 2012	Conference	IEEE PES ISGT Europe 2012 *Distribution Network Voltage Control using Energy Storage & Demand Side Response *An Interdisciplinary Method to Demand Side Participation for Deferring Distribution Network Reinforcement
23 October 2012	Newsletter	CLNR newsletter
24 October 2012	Conference	*ENA LCNF annual conference 2012
8 November 2012	Stakeholder event	*Sustainability First Smart Demand Forum
8 November 2012	Stakeholder event	British Gas regional Energy Services event
14 November 2012	Conference	Beyond Behaviour Change Systems of electricity & the constitution of 'smart' energy practices
20 November 2012	Stakeholder event	Northern Powergrid's 'Connections Progress Update' event
23 November 2012	Conference	UK Energy Strategy: Showcasing capability of the North East to deliver
26 November 2012	Media	New Statesman publication Will the UK's largest smart grid project revolutionise energy policy?

Table 1: Activities completed in this reporting period

2.46 At the Energy Networks Association Low Carbon Networks Fund 2012 conference, as well as the presentation, the CLNR project had an exhibition stand with hand outs of newsletter and academic papers, and an interactive CLNR model to demonstrate smart grid concepts and the work of the project. Prior to the conference, we created interest in the conference, smart grids and electric cars through publicising a journey by EV from Durham to the conference in Cardiff. This included social media (twitter, blog, Facebook), a press release which was widely picked up, and interviews with BBC local radio.

Figure 2: CLNR model

2.47 In its first month, the interactive model was used at three external events and has

proved very successful at stimulating interest in the project and explaining the current and future issues which smart grids can address.

Figure 3: CLNR exhibition stand

Activities planned for the next reporting period

2.48 For the next reporting period, the learning generated to date (as set out in section 8), will be disseminated, and additional communications structured around the deliverables of the project. In addition, we will continue to present at scheduled events such as academic and industry conferences and events, and reach a wider audience through selected general and specialist media. There is firm interest in the interactive model being used at events and conferences, and we anticipate that this will continue.

2.50 The CLNR LinkedIn group's membership will continue to be grown through active management; growth and sectoral interest will be measured and reported back on a monthly basis. The group also serves as a tool to drive more traffic to www.networkrevolution.co.uk.

2.51 The website is undergoing development work to maximise navigational ease and signposting; search engine optimisation (SEO) will be employed in the next reporting period to further drive traffic to the site. The target is to increase traffic to www.networkrevolution.co.uk by 5% month on month.

2.52 Public relations activity will be ramped up significantly in the next six months to ensure fluid, effective and managed communication and dissemination of project learning. Press releases, opinion pieces and letters to editors will be distributed to targeted media through a cohesive and strategic forward-looking communications plan.

3 Business Case Update

3.1 In the original business case for the project several key assumptions were made about the nature of network penetration and of the uptake of low carbon technologies (LCT).

3.2 Much as at the end of 2011, no new quantitative data, from sufficiently authoritative sources such as those used in the original assessments, has emerged in the last year which would lead us to re-evaluate the business or carbon case. Take-up for the LCTs has not been precisely the same as the models suggested for year one but for a 40-year projection this would not be expected anyway.

3.3 Some additional information regarding LCT take-up is available but this remains largely qualitative and no new definitive information is currently available which has been sufficiently tested to cause us to revise the business case.

3.4 The impact of technology clustering was assessed as part of the original model used to construct the business case. This has been the subject of some considerable research and further development during 2012. The outcome of this work is represented in the Smart Grid Forum Workstream 3 model. The impact of this modelling work is currently under review however, at this time the precise quantitative impact of the more sophisticated approach to clusters is still to be assessed. As with the LCT take-up models, new information is insufficiently mature to cause us to change the business or carbon cases although the changes in that information are considered in outline below.

New Information Considered On Installed LCT Capacity Take-up Assumptions

3.5 In the original business case, predictions of LCT units installed were based on conservative estimates, where possible drawing on more than one published study, from DECC, the Environment Agency, DEFRA and the Office for National Statistics. We continue to look for such credible, high quality studies to inform the project's business case preferring to rely on older higher quality information over more (potentially) unreliable but recent information.

3.6 The key LCTs considered for these estimates were photovoltaic generation, heat pumps and electric vehicles.

3.7 The figures available from these sources were primarily predictions. Since the original production of these figures some new data has been published on the actual number of connections. The issue with respect to the business case used here is that the changes are in the first few years of a trajectory that looks out to 2050. Taking such early changes into account and assuming that they represented fundamental changes in trends would tend to have a chaotic impact looking forward and have potentially a very large impact on the business and carbon case figures originally developed.

Impact of Changed Assumptions

3.8 The original analysis of potential photovoltaic (PV) microgeneration take up did not show any installations prior to 2015. The number of actual reported PV connections in 2011 and the rate of growth of connections into 2012 suggested that the number of installations in 2015 predicted in that model would be reached in 2013. Since the changes to the feed-in tariff arrangements the rate of PV installation has slowed

dramatically. As with the other low carbon technologies the precise quantitative nature of this change cannot yet be predicted, either in the short term or in the longer term.

3.9 BSRIA[1] and the report entitled ''Achieving Deployment of Renewable Heat" reported in 2011 that the take up of heat pumps was slower than previous predictions had indicated in the short term but would likely catch–up post 2020. A further subsequent report[2] has indicated that although domestic take-up has slowed, for a variety of identifiable reasons, commercial installations were likely to increase. The report is qualitative and the actual quantitative impact is not identified and therefore the impact on the business case for this project cannot be determined with any confidence at this time.

3.10 The anecdotal evidence that electric vehicle take-up is not going to be as strong in the short term as originally envisaged is increasing. The year 2011 saw only around 1000 vehicles registered[3] and there would need to be an extremely large increase in purchases of electric vehicles if the mid-range assumption used for the business case for this project of 130k is to be met.

Changes in LCT Clustering Assumptions

3.11 The impact of clustering of low carbon technologies could be significant as it puts excessive strain on localised parts of the network and requires action to be taken much earlier than would be expected if it were assumed that the take up of LCTs would be more evenly distributed. This aspect appears to be at least as important as the impact of the individual technologies themselves.

3.12 In the original business case the impact of clustering of LCTs was taken into account as it had been recognised that there were already associated issues on the distribution network. At the time it was assumed that 50% of the installed LCT technologies would be installed on 20% of the overall network, with the balance being distributed across the remaining 80% of the network. The Smart Grid Forum Workstream 3 work has replaced the original two band model with a five band model. Whilst this presents some potentially different scenarios for the clustering behaviour impact the middle of the road, conservative scenario would appear to be in line with the original 20%/80% assumption.

3.13 The range of scenarios in the Workstream 3 model indicate that some parts of the network could see considerable degrees of clustering and that the potential impact of the project outcomes for those parts of the network are likely to be significantly higher than previously expected, although this may be balanced by less impact elsewhere.

3.14 The impact of clustering is clearly important. The Workstream 3 model takes into account the impact of clustering and we are currently using this to assess both the impact of such clusters and the impact of the various mitigating technologies that might be used to tackle this issue. This work should deliver an assessment of the likely impact on the network of clustering and of the likely impact of the technologies and methodologies being developed as a part of the CLNR project.

[1] BSRIA, Heat Pumps UK, World Renewables 2010, Johannes Fritsch, 2011
2 BSRIA, Does The Heat Pump Market Still Have Energy, April 2012
[3] Society of Motor Manufacturers and Traders, January 2012.

4 Progress against Plan

4.1 The project continues to be operated to a detailed plan that will deliver substantive learning outcomes by December 2013. Key achievements and notable events are highlighted below.

4.2 During the period the customer recruitment phase has been substantively completed for the customer facing trials in learning outcomes 1 and 2 and the customer monitoring phase is well underway.

4.3 In addition, in learning outcome 1 we have undertaken the first set of analysis against around 5,000 residential customer smart meter records and disseminated these findings.

4.4 The demand-side response (DSR) research project with the aggregator Flexitricity has been completed, and the project is on target for recruitment of DSR participants into the summer 2013 I&C DSR trials.

4.5 In terms of achieving the 2012 SDRCs, the milestone to host the CLNR Distributor Review event in the current reporting period was completed on 12 July 2012 at Durham Energy Institute. Of the remaining four 2012 milestones, the three relating to the provision of load profiles are running to plan but the one associated with the installation of all network technology by December 2012 will be missed due to the issues already discussed in relation to the supply of the electrical energy storage systems and the secondary transformers with on-load tap changers.

4.6 Particular customer type scarcity in learning outcomes 1 and 2 and the supply chain issues in learning outcome 3 has had the effect that certain customer monitoring and network technology trials, followed by their analysis and reporting will extend beyond the project end date of December 2013. A plan review, currently on going, will confirm this situation. We are evaluating a proposal to deliver the bulk of the learning as intended in 2013 with a follow-up addendum report in 2014; as originally proposed for some of the customer trials. Following the plan review, this will be discussed with Ofgem in quarter 1, 2013. We are not forecasting any cost variances to the total project spend of £31.0m.

4.7 In the areas of customer scarcity; Heat Pumps (HP), Electric Vehicles (EV) and direct controlled household goods, then the time taken to both recruit and engineer the required technical solutions have pushed the project behind plan. These delays will result in certain project findings being analysed early in 2014 and published and disseminated in the first half of 2014.

4.8 In the learning outcome 3 network trials, delays have been incurred as a result of supply chain issues with two suppliers for electrical energy storage (EES) and enhanced automatic voltage control (EAVC). This has delayed the start of the network trials with this equipment, in particular the large 2.5 MVA storage device located at Rise Carr primary substation. These delays will cause the project to miss the SDRC milestone of installing and commissioning all network equipment by 31 December 2012.

4.9 In our last report it was proposed to Ofgem that the project closedown report will include all the learning completed by the end of September 2013, however for heat pump and electric vehicle customers, in so far as continued monitoring would deliver further learning, it was proposed to collect data up until the end of December 2013 and report on that data post-December 2013 in an addendum report. Subject to the on-going review of the plan, it is now considered prudent to also include the direct controlled household goods, and certain of the combined network technology field trials with the GUS control system in this 2014 addendum report.

4.10 In summary, the proposed plan is to address the delays encountered to date by delivering a substantive learning report by the end of December 2013, followed up by an addendum report in 2014 that addresses the outstanding gaps. This proposed approach maintains the focus on issuing important learning as soon as it is available.

5 Progress against Budget

5.1 The project budget is currently 40% spent and it is forecast that there is sufficient budget, due to efficiency savings, to continue the project learning into 2014 to complete the customer monitoring and the network trials.

Project Direction Category	Costs to Date (Nov-12)	Total project forecast (relative to project direction)				Forecast variance (relative to June 2012 progress report)		
		Direction	Forecast	Variance		Jun-12	Variance	
	£m	£m	£m	£m	%	£m	£m	%
Box 6 (Employment costs)	0.967	3.481	4.561	1.080	31%	3.317	1.244	37%
Box 7 (Equipment costs)	7.357	11.025	11.560	0.535	5%	12.964	(1.404)	-11%
Box 8 (Contractor costs)	3.663	11.363	11.155	(0.208)	-2%	10.422	0.733	7%
Box 9 (Customer and user payments)	0.207	0.769	0.586	(0.183)	-24%	0.810	(0.224)	-28%
Box 10 (Other costs)	0.054	4.360	3.173	(1.188)	-27%	3.511	(0.338)	-10%
Total costs	**12.247**	**30.998**	**31.035**	**0.037**	**0%**	**31.024**	**0.011**	**0%**

Table 2: Progress against project budget

5.2 This forecast saving is expected to be delivered primarily by the reductions in customer monitoring equipment and decommissioning cost due to the lower customer numbers in some of the test cells and a release of some contingency as the cost of the network technologies firms up.

6 Bank Account

6.1 During the week commencing 3 December 2012 Deloitte conducted a review of the transactions on the memorandum account. The outcome of this review was successful and no significant issues were noted. The report received from Deloitte can be viewed within Appendix 1: Audit of Memorandum Account Transactions.

6.2 During the week commencing 3 December 2012 Deloitte also conducted the second 12-monthly review of the financial tracking and reporting system to confirm compliance with the project bank account section of the Project Direction. The outcome of this review was successful and no significant issues were noted. The annual report received from Deloitte can be viewed within Appendix 2: Audit of Financial Tracking & Reporting System.

6.3 Confidential Appendix A: Memorandum Account Transactions lists the transactions between 1 June 2012 and 30 November 2012.

7 Successful Delivery Reward Criteria (SDRC)

7.1 The Customer-Led Network Revolution 'Knowledge Sharing and Learning in Action' stakeholder event took place on the 12th July 2012 at Durham University, fulfilling the Successful Delivery Reward Criterion of holding a 'distributor project review meeting' by 31st July 2012.

All DNO groups and others in the industry attended this full day event which was based around three core themes: Network technology, Process and Outputs. The slide pack used on the day is available in the project library on the CLNR website and additional information is available in Appendix 3 – .

7.2 There are five SDRCs due for completion in the next reporting period and these are:

Customer Monitoring	Demand profiles grouped by customer type	31 Dec. 2012
Customer Monitoring	Demand profiles grouped by low-carbon technology type	31 Dec. 2012
Customer Monitoring	Output profiles of existing generation types	31 Dec. 2012
Network Trials	Complete installation and commissioning of network equipment	31 Dec. 2012
Customer Trials	Output / Demand profiles before and after a range of interventions	30 Apr. 2013

Table 3: Successful Delivery Reward Criteria

7.3 All of the above SDRCs are on target for their completion by the planned due date with the exception of the SDRC for the Network Trials: complete installation and commissioning of network equipment.

7.4 In the learning outcome 3 network trials, delays have been incurred as a result of supply chain issues with two suppliers for electrical energy storage (EES) and enhanced automatic voltage control (EAVC). This has delayed the start of the network trials with this equipment, in particular the large 2.5 MVA storage device located at Rise Carr primary substation. These delays will cause the project to miss the SDRC milestone that is due on 31 December 2012. The milestone is forecast to be completed by end of quarter 1, 2013.

8 Learning Outcomes

8.1 This section describes the main learning outcomes from the reporting period. Section 2 contains details of the communication and dissemination activities of the project during this same reporting period. This report is just one way in which the learning below will be disseminated, and further action will be taken to actively communicate this learning to interested stakeholders in a relevant and timely manner.

Marketing Campaigns

8.2 The marketing campaigns which have been carried out as part of the domestic recruitment exercise have continued to prove successful, with the outbound telephone recruitment campaign to Economy 7 tariff customers in order to recruit for the electric heating and hot water trials achieving the highest conversion rates so far:

- Time of Use Tariff - TOU (8%): Mailed 23,227, had 1,847 responses;
- Photovoltaic - PV (11%): Mailed 1,105, had 121 responses;
- Electric hot water - eHW (19 %): Called 456, had 87 responses.

8.3 The electric heating and hot water trials were redesigned to focus on recruiting off-peak electric heating customers. Following this redesign, it was assumed that it would be relatively straightforward to find these types of customers through targeting Economy 7 supply customers. This however led to some interesting and surprising findings, some of which have recently been echoed by a report by Consumer Focus on, "From devotees to

the disengaged":

- The majority of people approached about joining the E7 trials are retirees;
- 19% of the people spoken to no longer heat their homes electrically, having moved to gas;
- 12% of the people spoken to do not have broadband;
- Of the people recruited to date 79.5% electrically heat hot water and the home, 20.5% heat hot water only electrically.

8.4 British Gas is now taking steps to contact the customers identified to have gas central heating to advise them of a more appropriate electricity tariff.

8.5 The DECC funded heat pump installation programme running parallel to the CLNR project has identified in total, approximately 950 customer prospects. These are almost exclusively in the social housing sector. Of these, approximately 500 were not taken forward, 100 of those were tenant refusals, with the main reasons given as follows:

- Happy with existing system;
- Not sure about technology/low confidence;
- Upheaval is a big issue/didn't want larger radiators.

Monitoring and Communications

8.7 The majority of the residential trials required the installation of home area network hubs/gateways in order to communicate with installed monitoring/intervention technology. These have proven a challenge for installers for two reasons:

- Time taken to download 'new' software updates;
- With the 'ZigBee' communication network, the location of the hub has in some instances been a challenge as existing routers can be out of sight and therefore wireless communication paths are obscured;

Our experience has been that installation contractors have been typically using qualified electricians to install the required hubs and devices in the home. Often this resource lacked the skills to tackle communications issues that occurred during installation and required additional training.

8.8 No inter-compatibility between hub devices from different suppliers. This has been a consideration when making decisions on suppliers, where more than one technology is required. (e.g. whole house monitoring, smart appliance, communications hub). Should connected home services become widespread, this may also influence customer choice as we could assume customers would not want numerous hub devices linked to different appliances in their home.

8.9 Although Smart Plugs have extended the range of the 'ZigBee' network in homes, by their very nature it does mean they are prone to accidental removal by customers or signal paths being interrupted by furniture / personal belongings.

Hard wired Smart Switches are a more secure option in that they can't be removed easily however install times are increased due to the actual installation and damage to decorations may result.

- Customers should be made aware of limitations of smart plugs through product literature or via the installation engineer;

- Wireless 'ZigBee' devices may not be suitable where communications certainty is required or for data critical applications.

8.10 Despite the fact fixed line broadband uptake in the UK is reported at 67% (Ofcom Communications Report August 2011), we have found this rate to be much lower amongst social housing customers with only 45% take up in this sector. Social housing has been thought of as a good prospect for aggregated domestic demand side management. However, this has significantly limited the number of homes we have been able to install broadband enabled communication hub devices. Given the customer scarcity and the additional importance of monitoring each heat pump installed as part of the conditions of the DECC grant, the project has taken the decision to pay for one year's subscription of broadband and also to provide assistance in setting up the account and hardware.

- Do not rely solely on fixed line, broadband connectivity when designing the connected home and smart grid products/services of the future. Consider GSM, satellite etc;
- Careful consideration should be given to the real level of connectivity within the UK and overall awareness/understanding/familiarity of the basic levels of broadband connectivity within the UK as experience from CLNR suggests this is not as prevalent as may be assumed, and is very specific by customer segment/demographic.

8.11 Fixed line broadband as a communications gateway for smart devices poses at present, a major barrier to deployment. Issues include:

- Customers switching broadband off at various times for reasons ranging from energy efficiency to fire safety;
- Routers not having a spare ethernet ports for other connections;
- Wifi connectivity has not proven a reliable choice for connection to smart devices due to issues of security, range, password maintenance etc;
- Location of router relative to the smart services (physical location, availability of mains sockets nearby for additional equipment etc.);
- Reliability of internet connection for guaranteed services such as demand response etc. is not certain.

8.12 The CLNR project has found that almost a fifth of homes approached (15-20%) no longer have or use fixed landline phones. This was particularly noted in social housing. Customers no longer see these as a necessity as many telecommunication companies offer packages that enable consumers to have calls and internet access at low rates, and therefore extra expense of fixed phone lines and internet are not required. Furthermore, the rapid increase of mobile broadband, the rise of tablet computing, and the launch of super-fast 4G may end up eroding the general up take of fixed line communications in future.

8.13 It was found that smart meters cannot provide all the functionality required by the CLNR trials such as 10-minute intervals, power quality monitoring, etc. which has necessitated the installation of secondary meters to capture this data and also to capture disaggregated circuit monitoring data where applicable. To do this without disturbing the cut-out fuse, it is necessary to isolate the electrical supply via a Double Pole Isolator (DPI). Unfortunately not every home has a DPI and so in many instances these had to be fitted prior to the installation visit to install the trial specific monitoring equipment.

According to MOCOPA regulations, a DPI can only be installed by a licensed meter

operative directly contracted to the customer's electricity supplier, which has introduced delays into the project timetable. A change in regulation would be required to allow for any trained and qualified licensed meter operative to fit a DPI, regardless of supplier. This has already been recommended by British Gas and a decision is expected by the end of 2012.

Low Carbon Technologies

8.14 The Neura 'Nano' smart air source heat pump, combined with the 300/500l Gledhill thermal store and control system designed for the project appears to be capable of providing the communications and peak load shifting required for the project as well as cheap and efficient operation. It does, however, come with some significant constraints:

- Very large outdoor unit limits property suitability and is only permitted development in Wales;
- The very large and heavy (263kg) indoor unit requires rear access to the property, bespoke lifting procedures and is not suitable for most airing cupboards;
- Requires robust uninterrupted internet connection and unshielded data cable, which have resulted in sensor breaks.

The physical and technical constraints of the smart heat pump solution developed for CLNR as well as the complexity of the installation and set-up make it a niche product for the UK market at present.

8.15 In line monitoring has proven to be an issue when installing the equipment on heat pump systems due to the manual start up process of the internal unit on some models. In some instances a manual start-up process of re-establishing the power had to be followed. If not, the heat pump would not restart and would leave customers with no heat or hot water until the manual start up procedure was carried out. This is being managed by:

- Ensuring installers are aware of potential start up procedures/ issues when switching the power off to an appliance to retrofit monitoring equipment;
- Implementing a documented quality check to ensure the appliance is working correctly before leaving site.

8.16 At present the installation of domestic multi technology microgeneration is blocked by DNOs subject to an impact assessment on the grid and submission of G83 application for "Prior Distributor Consent for Connection of Multiple Installations". This issue has been raised where customers who have existing PV systems wished to add micro-CHP boilers. Despite both technologies having 'complimentary' seasonal consumption profiles, unless official permission is given by the DNO this multiple installation is not possible. This application process and paperwork is not obvious or convenient to customers and introduces a barrier to the uptake of multiple technologies. The project should provide learning to inform the need for this process and consider whether changes to G83 should be proposed.

8.17 Given the current customer scarcity on micro-CHP, the project is subsidising the installation of new micro-CHP boilers. Three appliance options were investigated and due to technical and market readiness, the decision was made to use the Baxi Ecogen which British Gas already offered to customers. This decision was made on the basis that the project is looking to test the impact of micro-CHP on the network and not to test prototype technology and it was thought less risky to proceed with a tried and tested

solution.

8.18 Despite the offer to subsidise over 50% of the installation, take up of the Baxi Ecogen has been low. This is because of its physical size and siting of the appliance, with weight and noise posing the greatest barriers to uptake. So far we have managed to secure 15 new installations with almost all of them coming through British Gas' replacement enquiries and one being a new build. The remaining five are planned to be installed in social housing.

8.19 Due to reductions in the Feed-in Tariff, solar PV customers may have to move away from the notion of purely financial benefits and the benefit of using generated energy when it is available. CLNR should give us an insight into whether an automatic or manual balancing solution adds the most value for the customer.

8.20 Technology and appliance manufacturers (Indesit Company) have insisted the user experience is the first priority when it comes to the 'Connected Home'. As part of this they also note that any remote control by a third party should not be made available to the detriment of the appliance's intended functionality. This has meant that the customer will always be given the option to override any type of remote control and also that interruption of the appliances function is not possible. This compromise suggests that rather than being able to rely on Direct Control customers 100%, some kind of confidence interval will need to be applied if it is to be used for network balancing.

- Future direct control product/service development should aim to maintain appliance functionality as a top priority and making available load for shifting a 'background' process;

- If an override facility is provided as part of a Direct Control proposition, a confidence interval should be established through customer trials and testing before the commercial value to the network can be relied upon for network balancing.

SME Trials

8.21 Project time constraints has meant that some SME sites had to be removed from the trial as there wasn't enough time to wait for the smart meter installation. The conversion rate for SME customers from traditional to smart is low, and there are many different factors which lead to cancellation of a smart meter.

8.22 The migration of Meter Operator (MOP), required by the project has continued to reveal significant challenges, resulting in high levels of customer exclusion from the trials:

- British Gas' meter operator could only communicate with one type of (B2B) meter;
- Older smart meters have limited memory space;
- Incorrect meter IDs on system cause mismatches in data;
- Without checking each meter in advance, this could not have known this up front, and the churn expectations were too low.

8.23 Early indications are that SME customers signing up for ToU tariff appear to be unwilling to change behaviour to any great extent to access cheaper rates resulting from the tariff structure. This is particularly the case if such changes have an impact on their business operation. It is clear that the rewards for this activity are significantly outweighed by a concern on the impact of everyday activities, and that the rewards would need to be much higher to drive such change.

8.24 Smart metering (non-residential) is still evolving within the industry; this means that we

aren't yet at a stage where all providers can communicate with any smart meter. Therefore even if a meter operator is the appointed agent it is not always possible to communicate with the meter to get interval data.

8.25 Through experience, the project has realised significant barriers introduced by the non-standardisation of metering technology, the capability of various players in the supply chain to interact with meters in the market, and the lack of smart meter data storage:

- Each type of (business) smart meter has different memory space, some only hold as little as 12 days' worth of data;
- British Gas' meter operator currently doesn't hold the smart meter data for business customers, most new meters can hold around 12 months' worth of data, at the end of this period the meter memory is wiped, which means this data is no longer available;
- British Gas' meter operator could only remotely connect to/reconfigure one type of meter which reduced the number of eligible SME customers for the trial.

8.26 Procurement of the additional monitoring and intervention equipment required for the SME trials proved challenging. There appears to be suitable options for the smaller end of the business market/residential and larger industrial end of the market but very little for the medium business customer.

8.27 There were virtually no SME customers who would accept the restricted hours or direct control propositions once the full implication of its impact on core activities was understood by the on-site staff. This was despite their previous agreement to this during recruitment.

Many SME customers had already taken steps to shift or reduce energy consumption, which meant there would be little or no further changes they could make to their business.

Industrial and Commercial (I&C) customer trials

8.28 The interim I&C customer survey conclusions are:

- When targeting a tight geographic area the initial customer drop-out rates are high due to: issues associated with contacting the sites, contacting the right person at the site and the size of site load (e.g. sites less than 200kVA may not be considered practical for bespoke I&C contract structures).
- When contact is made with the right person in the business there is a low level of awareness of what DSR is amongst customers. Of the 20 customers (> 200 kVA) asked if they had heard of the term 'demand response' or 'demand side response' only three had the correct understanding of the term.
- When the concept of DSR is explained to customers a large proportion of customers want to understand more about the practical opportunities. For example 12 of the 20 respondents (> 200 kVA) were interested in understanding more about the opportunity once it was explained that some businesses can generate revenue from providing DSR.
- The prospect of customers investing time and resources to develop their DSR capability did not represent a barrier with 17 of the 20 (> 200 kVA) customers still interested in DSR.
- Remote control access and control of customers' assets was not a barrier to the next stage of the DSR implementation process.

- Even if customers show a positive interest in the DSR concept there may still be issues with some sites as further investigations identified no scope to provide DSR, not a high enough demand at the site or load profiles that did not correlate with the load profile of the primary substation.
- The implementation of DSR from generation substitution is the most successful entry point for new I&C customers wishing to participate in DSR schemes. Following this first step, customers can then engage in further developments that may be more intrusive to their core processes such as load management or energy efficiency.
- The lead times from making initial contact with a customer to finalising a DSR contract can range from 12 to 24 months. DNOs will have to ensure these lead times are accounted for in the network design process if DSR is to be implemented as a practical alternative to network reinforcement.

Social-science perspective

8.29 The first Interim Report from DEI's social science team has contributed a series of initial observations into current electricity demand and the potential flexibility of demand in future. These findings are drawn from early analysis of the data generated in face to face visits to customers which included semi-structured interviews and energy tours of customers' properties – both SME and domestic. It is vital that these findings are read and treated as preliminary, as they may undergo revision as the data collection and analysis stages of DEI's work progresses. The initial findings are focused in the following areas:

- Electrical intensity of practices/ activities/ load types;
- Factors shaping electricity use;
- Factors causing energy use/ practice to change over time;
- What flexibility in energy use means in a domestic and SME context; and
- What enables and constrains demand flexibility.

Learning from the network technology trials installation phase

8.30 Learning occurs from any installation process due to the unique condition that each site may hold such as unexpected ground conditions or archaeological finds. However, in this case, initial network learning has been gained from a number of activities. Below, we have broken down the key outcomes of these activities:

- Supply and fitting of Rogowski coils around exposed and enclosed bus bars and low voltage conductors;
- Engineering a safe, fused, insulated voltage take off device suitable for connection on traditional open low voltage bus bar arrangement substations;
- Preassembly of monitoring equipment before site works to reduce the on-site time and reduce the exposure of field staff to the elements, and have an environmentally clean controlled workspace;
- Replacement of existing soil type around thermal and soil resistivity devices to avoid misrepresentation of the existing soil geology and makeup;

Figure 4: Overhead line rating devices

Figure 5: Overhead line rating devices

- Installation of overhead line rating devices on 66kV tower lines cannot be completed using traditional hook ladders, due to the extended insulator strings, either suspension towers should be selected or alternative platforms should be used;
- The design of link boxes with embedded monitoring requires the use of water blocked cables to avoid the capillary action for moisture ingress into the monitoring box.

8.31 Other key learnings are listed below:

- The application and connection process for fixed line communications to distribution substations proved difficult to coordinate due to the substation not being lived in or having any means of postal contact;
- The resilience of GPRS communication networks have proved mostly reliable, however glitches have occurred that have caused some data transmission loss. UK communications providers do not roam between networks, so a global SIM card has been supplied from a Spanish provider which searches the strongest and most healthy network signal;
- Many of our sites have multiple technologies installed. To avoid rework excavations, ducts and cable routes have been manufactured and installed to lower the risk of damage to smaller than average control and communication cables within a substation compound and avoid the need to re excavate many times;
- To further avoid costs, coordination was required to install multiple control boxes into one water resistant housing area. This offered benefits of greater security, lower visual impact to the substation and reduced incentive for theft in some of our outdoor compounds;
- Overhead thermal rating equipment can be fitted using a live line / hot glove technique up to and including 20kV circuits with approved systems of work. The 30W solar panel is sufficient to power the overhead line system and weather station at its highest relay time of once per 5 minutes.

8.32 In delivery of the network equipment, there have been a number of learning insights that were not identified at the outset. These primarily relate to the installation of the thermal rating equipment and the preparation of the storage components. The learning insights include: the development of method statements, risk assessments, wayleave changes, security issues, safety case development, engagement with local authorities and fire services. Other initial findings relate to the outputs of the monitoring equipment that we

continue to roll out across our trial sites, including: monitored levels of power quality, system loading and phase imbalance, and information that informs system design at an early stage of network concerns. These additional unplanned outputs will be combined with the proposed learning schedule.

Learning from initial monitoring data derived from network trial areas

8.33 The four current HV overhead line sites on the Denwick rural network have shown that different real-time thermal ratings are derived at the same point in time for different locations on the same HV feeder. This is as expected due to the variation in site topology e.g. sheltered and open sites.

8.34 A paper was presented at CIRED 2012, entitled "Customer-Led Network Revolution - Integrating Renewable Energy into LV Networks using Energy Storage". This paper presents a solution to voltage rise issues arising from large-scale PV integration, using EES. It is based on data analysis from the PV cluster in Maltby, PSCAD simulation, and laboratory emulation. This study is an illustration of the "Validation", "Extension", "Enhancement" and "Extrapolation" parts of the VEEEG analysis methodology developed for the CLNR project.

8.35 An abstract entitled "Distribution Network Voltage Control using Energy Storage and Demand Side Response" has been accepted for ISGT 2012. This paper presents a solution using EES and DSR to control voltage drop issues related to high penetration of EVs and heat pumps. The research was carried out using an IPSA2 model of Denwick, results from I&C DSR trials, and simulation and emulation work carried out within DEI. Again, this study is an illustration of the VEEEG analysis methodology.

8.36 We are using a number of systems to gather and process data to support our learning. The conclusions to date are that dealing with a new data hosting solution is not a straightforward process, and there are many obstacles to overcome before the system can be used effectively. This is particularly the case for real-time control and rapid turnaround of results analysis. More specifically, our experiences are as follows:

- GE-FMC Tech data hosting system experience for the real-time thermal rating network devices shows that the data download function seems robust, and the functionality to download results for all data fields at all sites in one file is a useful system that is an open format which can be imported by many applications;
- Kelvatek data hosting has likewise produced some learning relating to its system. The learning relates to the limitations of using data that is not real-time. The data can be accessed only after a time delay, which varies from several hours to nearly one month, which means it is not suitable for real-time control. It is also difficult to download long periods of data. Missing data and duplicated data cause analysis difficulties;
- Finally, data hosting experience has been gained from the iHost (Nortech) system. This site does not have the same bulk data download function at present and is missing certain data fields (e.g. calculated RTTR). The current website login does not give us full access to the rating engine so we are therefore unable to modify the calculations for our research. As with the Kelvatek system, missing data and duplicated data are currently causing analysis difficulties that we are working to resolve.

Learning from the solutions development work stream

8.37 The process of collecting and delivering large volumes of smart meter data for analysis has not been straightforward. As information from smart meters is intrinsic to the concept of a smart grid, being able to understand and overcome the issues faced on CLNR is important learning.

- Privacy and commercial concerns have required the implementation of a complex solution for transferring and analysing data;
- Within the supplier the use of third-party outsourced data handling has led to unexpected outcomes: existing business practices and contracts do not allow for rapid data querying; the data itself suffers from dropouts and loss; data rates and connectivity to meters can be poor; billing systems are not designed to allow access needed for detailed and sustained analysis;
- Required IT security standards are tightening all the time, and future projects such as CLNR will need to look ahead in the planning phase to the information landscape two to five years into the future.

8.38 There is an apparent "value gap" surrounding demand side response. Frontier Economics' tariff paper for CLNR suggested that there is little value to an individual customer providing DSR. However, such a service, in aggregate, would be of high value to the DNO. Understanding how to close this gap and provide a service which is of value to all participants is useful for the industry.

8.39 The Irish Trials (CER Smart Meter Customer Behaviour Trials) have provided CLNR with an important model for data dissemination, and have provided some important supplementary data that will be incorporated into CLNR analysis. In particular the design of the customer surveys has influenced survey design for CLNR.

8.40 The EDRP study data has not been forthcoming yet but the project report itself has provided valuable information on smart meter trials. The learning from EDRP has been related to the learning outcomes for CLNR and will be used to inform our results.

8.41 In the process of developing advice for updating ACE49 and ETR130 we have assessed the original assumptions which informed the historical studies to re-evaluate current and future load and generation profiles. On ACE49 we have successfully engaged the involvement from part of the original team that developed and implemented the methodology. As part of the overall learning outputs for this work, we are committed to documenting the process and making robust recommendations, so that research in future can be repeated or the findings challenged further.

8.42 In learning outcomes 4 and 5 EA Technology have continued work to determine the extent to which present document sets (policies, procedures and guidelines) will remain valid as low carbon network solutions become adopted.

8.43 EA Technology have progressed studies into the impact of the technologies being trialled in the CLNR project. In the process the following insights were identified.

- In the last report, it was stated that approximately 37 of 224 external documents (national and international standards) referred to in the policy and procedure documents researched, would be somewhat impacted by the adoption of the new network technologies and ways of working being investigated in this project. At present, this proportion is similar. Approximately 37 (15.5%) of 241 external documents have been identified as being somewhat impacted, and a further 11 (4.5%) being identified as being majorly impacted;

- In a similar analysis of the policy and procedure documents of a master list of 89 documents (adjudged to be the most critical business guidance documents), it was found that 17% would require significant amendment, a further 45% would require some attention and the remainder required no further amendment;
- Perhaps unsurprisingly, there are significant overlaps in the key knowledge requirements between different staff groups strongly indicating the case for the development of modular training material in the later stages of the project;
- The initial assessment of the impact of low carbon technologies and network solutions on operational procedures and safety rules has highlighted requirements for attention. In particular, procedures for the operation of electrical storage and new control room equipment as well as in the area of power system protection and distribution safety rules related items;
- In addition to staff groups from call centre staff to asset management staff, it is also signalled that contractors, meter installation staff and other non-DNO staff will have a potential impact on their operating procedures as low carbon technologies and network solutions are adopted.

Summary of findings from initial pre-trial network analysis

8.44 An initial pre-trial network analysis was conducted using the models of Denwick HV network, Wooler Bridge LV network and Wooler St Mary LV network, to evaluate the capability of these networks to accommodate low-carbon technologies following deployment of EAVC2, EES2 and EES3.

- EAVC2 – OLTC equipped HV/LV transformer;
- EES2 – 100kW/200kWh Electrical Energy Storage (EES) located at the LV busbars of a HV/LV substation;
- EES3 - 50kW/100kWh Electrical Energy Storage (EES) located at the LV busbars of a HV/LV substation.

8.45 This has been achieved using validated network models and a combination of real and synthesised load and generation data. Steady-state IPSA2 models have been previously developed and validated using SCADA data and results from the Kelvatek units. This model has been extended by the addition of a detailed LV network model using Northern Powergrid supplied data.

8.46 The load data for the post-trial analysis study cases are derived from actual data from the SCADA system of this network. This is supplemented, in order to create realistic future scenarios, with load profiles derived through analysis of smart meter measurements, of 4,800 customers, and LCT profiles derived from salient literature and real data from trials.

8.47 This study focuses on the Autonomous and Single + GUS trials for the rural test CLNR test network at Denwick that will be carried out towards the start of the trial period beginning in February 2013. In addition, the baseline trial that is required to evaluate the headroom uplift accruing to the network interventions can be evaluated.

8.48 The network interventions, EES2, EES3 and EAVC2, can increase the allowable penetration rates of multiple LCTs. The increments of the allowable LCT penetration rates depend on the profile of LCTs, the location and control strategies of these network interventions. It was found that if the EES is located at the LV substation, the reactive power Q is more effective than the real power P for voltage control; if the EES is located at the end of the LV feeder, the real power P is more effective than the reactive power Q.

This is primarily due to the X/R ratio of the upstream system seen by the energy storage unit.

8.49 Controlling P and Q simultaneously was found to be more effective than purely controlling P or purely controlling Q. This is due to a number of factors:

- maximum reactive power is smaller than the rated real power of the EES units deployed as part of CLNR (product specification of A123);
- reactive power is not as effective as real power in terms of voltage control due to the X/R ratios that the energy storage units see.

8.50 In addition, it should be noted that real power is limited by the state of charge.

8.51 In terms of voltage control, the EES located at the LV feeder end, which is farthest from the LV substation, is more effective than the EES located at the LV substation. However, as a local solution, the EES at the LV feeder end cannot solve the voltage problems of the whole LV network. This issue is indicated by the following example.

8.52 Figure 6 shows the LV network model of Wooler St Mary used in this study. In this model, the longest LV feeder of Wooler St Mary, Feeder A, is modelled in detail and the rest feeders are modelled with a lumped load. As shown in this figure, Feeder A has two branches, and the busbars at the ends of these two branches are named as 7 and 22. The EES is connected at busbar 7 to mitigate voltage issues associated with the deployment of high volumes of LCT. This is because the busbar 7 is the farthest busbar from the LV substation and it has been found by simulation as the place where the voltage violation will happen at first, if no network intervention is implemented. Here PV is integrated into this LV network with the penetration rate as 80%, the EES will charge to mitigate the voltage rise problem at busbar 7.

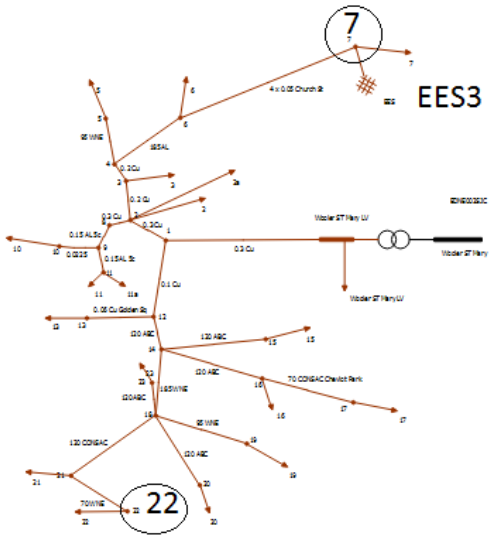


Figure 6: Model of Wooler St Mary LV network

8.53 Figure 7 indicates the voltage profiles of two branch ends of Feeder A, busbar 7 and busbar 22. It can be seen that the EES3 mitigated the voltage problem at busbar 7; however, the voltage violation at busbar 22 still exists.

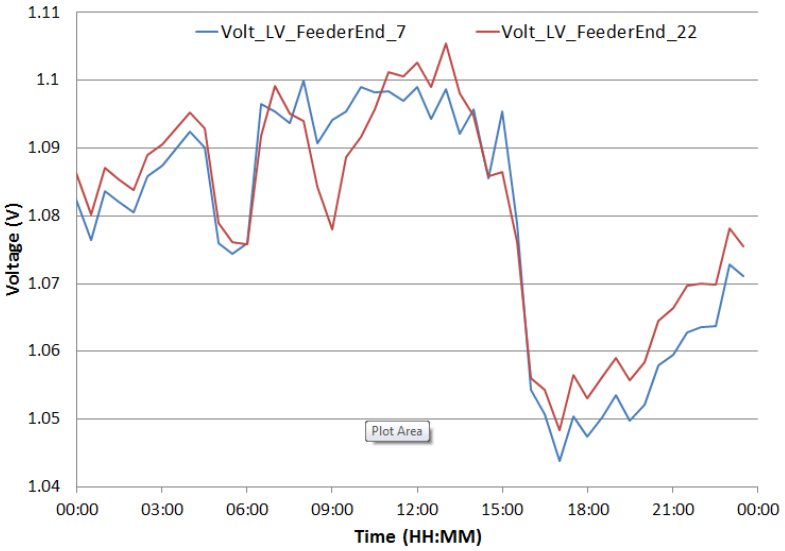


Figure 7: Voltage profiles with high penetration of PV

8.54 EAVC2 was also found to improve the capability of the network to accommodate LCT, especially when EAVC2 is used in GUS control mode. This is particularly effective when the LCTs were distributed evenly across the network as expected.

8.55 It was found that when EES2 is deployed in conjunction with GUS the system can accommodate higher LCT penetration rates than if EES2 is deployed in local control mode. However, if the threshold voltage of EES2 is set properly appropriately, EES2 under local control mode can achieve similar LCT penetration rates as the EES2 under GUS control mode. However, this may not be the case in practice. For the P control mode, the capacity limit of the EES2 will be easily met or the voltage violation problem at the LV feeder end will not be solved if the threshold voltage is not properly set.

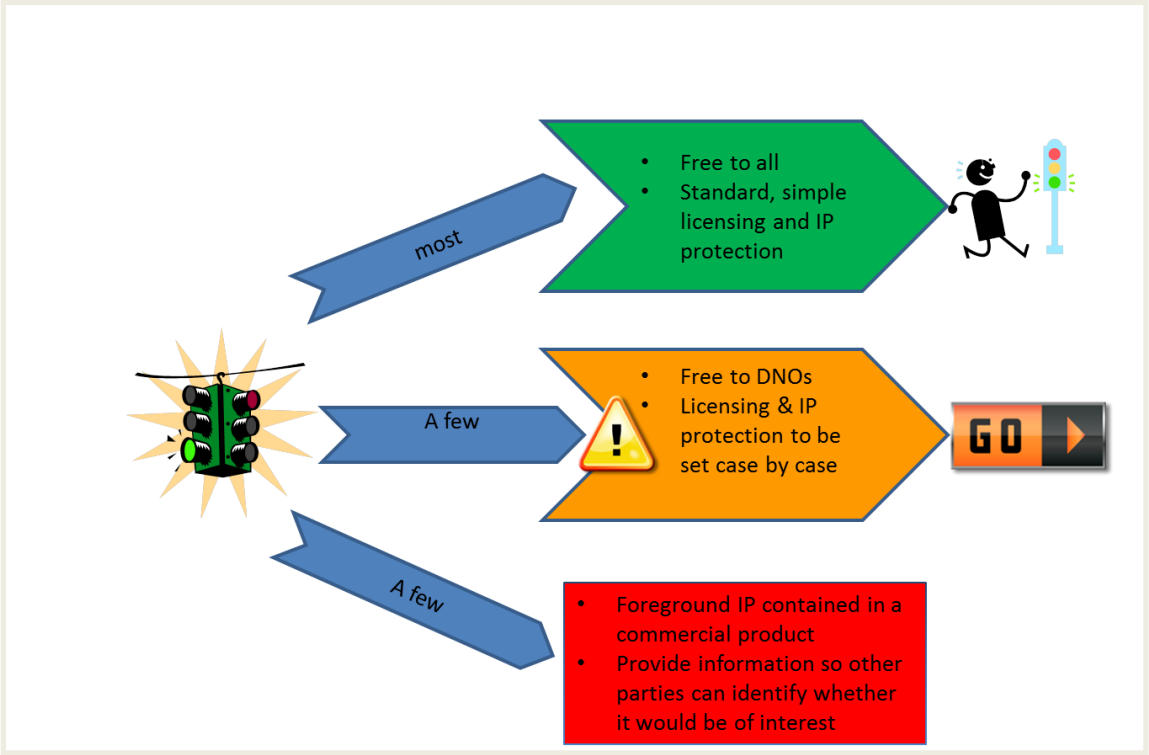
9 Intellectual Property Rights (IPR)

9.1 In this reporting period, the work of the project has generated the learning described in section 8, and created a number of artefacts which constitute foreground intellectual property. These are listed in Appendix 4 – Foreground IPR. No IPR has been registered, or royalties resulted, in this reporting period in relation to these.

9.2 Since the previous progress report, we have established a strategy for managing IPR which 'right sizes' the management of the foreground IP created by the project. The objective is to protect and license the IP in a way which recognises and is proportionate to the value of the IPR, is no more complex, time consuming or expensive manner than is necessary. Effort and expense may be focussed on a smaller number of high value items and/or complex situations.

9.3 Of the work which requires dissemination, we anticipate that most of this will be of 'research value' rather than 'commercial value' and our intention is to keep the arrangements for licensing and for protecting the IP of such materials simple and standard i.e. to go via what we are calling a 'green channel'.

9.4 There will be some items which are of commercial value, and for these items, access, licensing and IP protection arrangements will be determined on a case by case basis (i.e. 'amber' or 'red' channel) and in accordance with the LCN Fund governance arrangements.



Our next step is to consult with Ofgem and with other LCN Fund projects about this approach, and to take legal advice before fully implementing this approach.

9.5 We do not forecast any IPR registrations or royalties in the next reporting period. However, we anticipate specific measures for IP protection and/or licensing may be required for specific deliverables from the project, notably the working systems or prototypes delivered by the project e.g. the GUS control system, the NPADDS design tool, for training materials, and the air source heat pump with thermal store designed for the project.

10 Risk Management

10.1 This section provides an update on the five key risks identified in box 26 of the bid document. The original five risks were:

- Risk 1: Network equipment (EAVC, RTTR and storage) fails to operate as specified;
- Risk 2: Failure to deliver the integrated demand response system that links the network with the customers' equipment;
- Risk 3: Insufficient numbers of customers are recruited to populate the individual test cells;
- Risk 4: British Gas withdraws from the project; and
- Risk 5: Emerging findings indicate a major change of project scope is required.

10.2 Risks 1, 2 and 3 remain actively managed to mitigate the probability of their occurrence and the consequence of their impact. Risks 4 and 5 were mitigated at the time of the last report. The five key risks at that point were:

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

- Risk 2: Failure to deliver the integrated demand response system which links the network with the customers' equipment;
- Risk 3: Insufficient numbers of customers are recruited to populate the individual test cells;
- Risk 7: Lack of take-up for direct control;
- Risk 34: The risk of engaging with suppliers of emerging technology.

10.3 These remain the top five risks for the project and further detail is provided below.

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

10.4 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 have been designed to contain different combinations of equipment and network applications in order to avoid the risk associated with single point technical failure.

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

10.6 The risk remains high impact but the mitigation in place has reduced the probability to a low level.

10.7 Additional mitigation measures have been incorporated into the solution design for the new technology at our primary sites and our switched capacitor station, where the new install will be of a dual redundant system incorporating traditional upgrade works in tandem with the alternative control system relays and communication system.

Risk 2: Failure to deliver the integrated demand response system that links the network with the customers' equipment

10.8 Siemens has been appointed as the supplier of the grand unified scheme control system and this contract is progressing well with the specification phase and the factory acceptance testing completed. However, the risk level has not changed significantly from the time of the bid and the risk will remain in the top five until there is more certainty that the technical details for the connection between the control system and the controllable loads with I&C, SME and residential customers' premises have been installed, commissioned and function as designed.

10.9 We do however have the mitigation position, where we would utilise the control system to control the network technology and when required within the trial context to generate the demand response signal. This signal would then be despatched via a manual system where the signal is passed to either the commercial aggregator operating the I&C trials, or the British Gas DSR control centre/operative who then sends a signal out to the British Gas SME or residential customers. This approach, whilst not ideal, would still prove the DSR delivery concept and enable the key DSR elements of the project to be delivered.

Risk 3: Insufficient numbers of customers are recruited to populate the individual test cells

10.10 Customer scarcity issues were encountered at an early stage of the project in respect of heat pumps and electric vehicles and these two areas of risk remain.

10.11 The incorporation of DECC-subsidised heat pumps for deployment onto the trials and a decision to widen the recruitment channels to both include non-British Gas customers and to recruit out of region has increased the numbers of heat-pump installations significantly. Whilst recruitment is not forecast to reach the planned levels from the bid, in every heat pump test cell, we currently believe that there will be sufficient numbers to meet the trial objectives.

10.12 We have endeavoured to mitigate EV customer scarcity by three routes. Firstly by contacting customers who have adopted the British Gas electric-vehicle tariff, secondly by offering a fully-funded British Gas electric-vehicle charge point to incentivise participation in the restricted hours aspects of the trials, and thirdly by working to leverage in customers from the Northeast's Charge Your Car scheme by offering incentives on fully-funded charging / monitoring points.

10.13 Whilst we continue to pursue all of the above options, to date numbers of EV customers remain low. We have most recently updated our Customer Engagement Plan and Data Protection Strategy to take account of the opportunity with Charge Your Car and this remains our most likely route to increase EV customer participation to statistically significant levels.

Risk 7: Lack of take up for direct control

10.14 The bid proposal for direct control included:

- Residential general load (hot water and wet white goods test cell 11a);
- Electric vehicles (test cell 17);
- SME general load (test cell 11b);
- Heat pumps (test cell 14).

10.15 Customer scarcity has had a profound effect on recruitment for the direct control test cells.

10.16 The electric hot water direct control test cell 11a has been modified from a flexibility trial to a monitoring trial due to the lack of customers heating hot water during peak hours.

10.17 The electric vehicles direct control test cell 17 was dropped due to both a lack of available EV participants and the fact that the tariffs predominantly being offered by suppliers were already giving a price signal for consumption to move out of the peak period.

10.18 In the SME direct control test cell 11b, the recruitment of SME customers into this test cell was originally relatively high with 106 customers being recruited out of a target of 150. However we then encountered issues at the pre-installation survey phase, where customers became unwilling to offer their high consumption loads up for direct control due to the business criticality to their operations. This has caused all customers to withdraw from the trials. We are currently capturing the learning from the recruitment exercise and what this means for SME demand-side participation.

10.19 In terms of the direct control of; wet white goods and heat pumps, we are forecasting recruitment of customers into these test cells, due to the provision of 150 fully funded controllable washing machines, plus the innovative and award winning heat pump

thermal storage variant installations.

Risk 34: Contracting with suppliers of novel technology

10.20 In addition to the risk of the specified technical functionality not being available, we have demonstrated the enhanced supply chain risk with providers of novel technology.

10.21 In the project to date, there have been examples where supplier lead times have been significantly greater than our initial planned expectations, whether due to; constraints within the supplier's own supply chain or the requirement for safety case risk assessments or type testing, in order to manage the introduction of new technology onto the network.

10.22 Market readiness and compatibility of novel technologies have also contributed to delays in our control system design, which include the configuration detail required between the control system provider and the manufacturers of the END devices. Physical, software and protocol compatibility between multiple suppliers has been identified as part of this risk.

10.23 Whilst we have planned ahead wherever possible, we have had two incidents that have adversely affected our delivery timescales.

10.24 Firstly our storage device manufacturer A123 Systems Inc. entered Chapter 11 bankruptcy proceedings on the 16th October 2012. We have worked with A123 to minimise the risk of not receiving our storage devices and to that end have agreed to a modified delivery schedule and accelerated payment terms on certain key sub-contract items. Our final commissioned date for the large storage device at Rise Carr primary is now forecast to be in mid-March 2013.

10.25 Secondly we have had slippage against our year end delivery plan for our EAVC devices, namely the HV Transformers with on-load tap changers. These devices were subject to a previous risk, risk 29 regarding the original manufacturer of these units ceasing its production. Current issues with the availability of prototype component parts in the new supplier's supply chain have caused the units to miss our year-end installation and commissioning deadline.

11 Other

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

- Appendix 1: Deloitte Audit Statement – Memorandum Account Transactions
- Appendix 2: Deloitte Audit Statement – Financial Tracking & Reporting System
- Appendix 3: SDRC Evidence: Distributor Project Review Meeting
- Appendix 4: Foreground IPR
- Appendix 5: Progress in Recruitment and Data recorded

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.
External auditors have certified Northern Powergrid's accounting arrangements for the project as being satisfactory, and will 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 2012 and is included in this fourth progress report.	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.

Step	Rationale
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

17 December 2012

Appendix 1 – Deloitte Audit Statement – Memorandum Account Transactions

Deloitte.

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11th December 2012

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 1st October 2012, 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 2012.	We obtained the Company's schedule for the 6 month period ended 30th Nov 2012.
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.

Deloitte.

Select a sample of 25 transactions from the schedule and perform the following:	
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.

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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

Deloitte LLP
Chartered Accountants
Newcastle Upon Tyne, United Kingdom

Appendix 2 – Deloitte Audit Statement – Financial Tracking & Reporting System

Deloitte.

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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

11th December 2012

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 8th October 2012, 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.

Deloitte.

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 2012 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.

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.

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 3 – SDRC Evidence: Distributor Project Review Meeting

Introduction

The Customer-Led Network Revolution 'Knowledge Sharing and Learning in Action' stakeholder event took place on the 12th July 2012 at Durham University, fulfilling the Successful Delivery Reward Criterion of holding a 'distributor project review meeting' by 31st July 2012.

42 delegates attended the event on the day, this included a diverse range of representatives from Ofgem, all the mainland UK DNOs (Electricity North West, Western Power Distribution, UK Power Networks, Scottish Power Energy Networks, SSE, and Northern Powergrid), ENA, Logica UK, National Energy Action, University of Bath and Nortech, as well as CLNR project staff from Northern Powergrid, EA Technology and Durham University.

The full day event was based around three core themes: Network technology, Process and Outputs. An agenda for the event can be found at the end of this Appendix 3. The slidepack used on the day is available in the project library on the CLNR website.

To understand the outcomes of the event, an evaluation form was circulated at the event. 23 forms were completed (Over 50% response rate). Delegates commented positively on all of the presentations and confirmed that they were able to network proactively with other peers in the energy sector. The event was attended by a high level and good range of delegates, who commented positively on the organisation and format of the day.

The remainder of this appendix comprises evaluation of the feedback from delegates, followed by the agenda for the day.

Networking opportunities:

The design of the event provided a good platform to encourage active discussion and there were several opportunities to network throughout the event; during registration in the morning, at lunchtime, during the afternoon refreshment break and after the event had finished. There were also opportunities to network during the laboratory tours which also took place throughout the day attended by approximately 30 delegates.

Delegates were asked what issues were discussed during their networking opportunities at the event, as expected; a lot of the discussion was focussed on the content of the day and themes surrounding the Low Carbon Network Fund (LCNF) project, showing that delegates really made the most of the opportunities to network. The (raw) qualitative evidence below illustrates feedback from delegates when asked what issues were discussed during the networking opportunities:

- 'Specification of equipment, cost of equipment, engaging people within your own business/organisation. Operation of equipment (new equipment/training)'
- 'Is utility-scale battery energy storage really credible?'
- 'Energy storage markets and technology'
- 'Discussed actual installations with Northern Powergrid and ScottishPower'
- 'Communications, storage, embedded generation profiles'
- 'Dissemination of findings, extraction of learning from project team, knowledge exchange between academics and other project partners, classification of knowledge/artefacts, LCNF conference – shared DNO (Distribution Network Operators) sessions'
- 'Requirements/opportunities to pool data'

- 'Internal project management processes, how the control system works'
- 'Knowledge management, electric vehicles, R110'
- 'Trials design/limitation, communications & dissemination'
- 'Possible meeting between our universities'
- 'Customer engagement, Low Carbon Network fund project, storage & DSR opportunities, policies & procedures – changes to, shared information, we need some quick wins and deliverables'
- 'Possible new directions for research/future collaborations/updates on findings from past projects'
- 'Knowledge sharing, project overlap, management and co-ordination of dissemination'
- 'Project size and complexity, project burden on existing company infrastructure, difficulties in delivery aspects'
- 'Matrix of trials with Phil Taylor'
- 'Need for DNOs/ENA to establish agreed standard for monitoring'
- 'LCNF communications – cross-project get-togethers, automated DR (via active network management)'

Delegate feedback: main technical, social and economic challenges facing DNOs (Distribution Network Operators) in the next ten years?

In order to gain some insight and feedback from the delegates, they were asked what they felt were the main challenges facing DNOs in the next ten years, their comments are listed below:

- 'Not knowing what we need to do'
- 'Not knowing what the customer is going to do'
- 'Not knowing if we'll have enough money to do it'
- 'Change policies to make it business as usual, not "reactive" but incremental and orderly evolution'
- 'Keeping it "simple", i.e. rules of thumb, so that everyone can understand what is going on'
- 'Technical – volume of connections applications'
- 'Social – relationships with supply and customers'
- 'Voltage regulation'
- 'Customer small distributed generation'
- 'Economic issues relating to customer usage'
- 'Electrification of heating'
- 'Electrification of transport'
- 'Increasing intermittent generator'
- 'Assimilating & applying learning from trials to make best use of networks'
- 'Lack of public visibility/understanding of DNOs'
- 'Conflict between need to interact with supply and generation parts of energy system and regulation to ensure independence/competition'

- ‘Planning in a changing environment’
- ‘Increase power demand’
- ‘Environmental regulation’
- ‘Ageing assets’
- ‘Pricing’
- ‘Integrating new and old in the most economically effective way’
- ‘Changing working practices and challenging “tacit knowledge” in the workforce’
- ‘Understanding social dynamics and their effect on the Distribution network’
- ‘Accepting new thinking – BAM processes’
- ‘Trusting DSR as genuine, reliable, technologies to defer reinforcement’
- ‘LC Tech’
- ‘Volatility of customers’
- ‘Uncertainty in future’
- ‘Customer engagement – supply hub changes’
- ‘New technologies – maintain flexibility in solutions’
- ‘Prove value for money’
- ‘Increasing demand’
- ‘Introduction of feed-in technologies’
- ‘Increasing energy prices’
- ‘Engaging customers and convincing them they are part of the solution for smart grids’
- ‘Safe, reliable and supply of electricity’
- ‘Accommodating LCTs’
- ‘Reducing workforce ability and size’
- ‘Collaboration with other UK & global projects’
- ‘Collaboration between DNOs/ENA to accelerate dissemination learning from LCNF projects’
- ‘Challenging commercial arrangements/Ofgem regulatory framework’
- ‘Investment by DNOs into software/IT systems to accelerate renewables connections/design’
- ‘Preparing for smart grids’
- ‘Internal cultural change within the DNO’
- ‘Conflicting messages to energy consumers – reducing consumption vs. shifting consumption. Tariff simplicity vs. tariff complexity’

Average rating of each session

Delegates were asked which presentation was of most interest and benefit to them. The sessions were:

a) Monitoring- How data capture leads to product optimisation

b) Energy Storage - trials and tribulations of full procurement

c) Real Time Thermal Ratings

d) Enhanced Automatic Voltage Control

e) Low carbon network Grand Unified Scheme (control system)

f) Network Field Trials - the art of effective design

g) Extracting Learning from the trials (VEEEG Methodology)

h) IPR and dissemination- challenge and complexity of management

i) Customer and generation profiles - analysing today's consumers and suppliers

j) The network designer's toolkit (NPADDS)

k) Social interest learning- the socio-technical approach

The answers were very mixed with good ratings for all sessions. However, the most popular sessions, by a narrow margin, were k- Socio-interest learning, and i- Customer and generation profiles. Qualitative comments relating to the sessions are recorded below:

- 'Harriet's (k)– because it's different to the traditional power-engineering type stuff. Changing customer behaviour is the "80%" solution – everything else is the "20%" solution'
- '(b, c, d, j) – personal interest/Low Carbon London, k) not really considered this level of social learning'
- 'Very interesting outcomes'
- 'f)-Field trials – method for extrapolating, k) socio-technical approach – answers questions on customers' engagement with smart grids'
- 'f) & g) – Network field trials/extracting learning. Need for all parties to input their learning to the local matrix. And j) the network designer's toolkit – we are also looking to enhance our toolkit for designers'
- 'k)-Socio-technical presentation from Harriet Bulkeley. Key enabler to DNOs understanding the role of SMART grids'
- 'b)-Energy storage due to tech background'
- 'I liked Pete's presentation (i) as data was new. I knew about the other stuff'.

Attendance at future CLNR events

All delegates who completed the forms said they would consider attending CLNR knowledge sharing events in the future, with comments:

- 'Yes, top priority activity for me'
- 'Yes, although maybe more appropriate for technical project managers'
- 'Yes, found the sessions very informative. Opportunity to network'

Informing future CLNR events

Delegates were given the opportunity to advise on any areas they felt should have been covered by the event as well as issues they would like to see addressed in future events. This provided an opportunity for delegates to shape the format of further events and contribute to future agendas. Comments can be seen below:

- 'I would like to be able to influence the direction of your project more, so that the outcomes are more applicable to our company'
- 'Excellent event – well done. The number of people in the room was about right. Any less, and it would have been too narrow, any more and it would have been difficult to manage the discussion. Excellent timekeeping as well. Thank you'
- 'Like the focussed nature of the event'
- 'Thanks for a good event!'
- 'Liz posed a question- what how and when in dissemination. Would have been an idea to have a small group discussion and feedback – missed opportunity'
- 'So many topics to cover, so little time. Each speaker had enough time to convey their messages'
- 'All covered'
- 'Perhaps a short workshop on specific technical issues to be debated and output shared'
- 'More customer engagement (recognising it was designed as a technology event)'
- 'Possibly more opportunities for group discussion, e.g. table discussions'
- 'Good content, well managed'
- 'Resourcing/delivery issues – use of international staff or need to find contracting resources. Challenging procurement as LCNF is research and development/Innovation'
- 'All good!'
- 'Would like more info on issues faced and solutions.'

Agenda

09.30 – 10.30 **Registration, refreshments and networking**

Optional tours (1) of Durham Energy Institute's state of the art laboratory at 09.30 – 10.00 or 10.00 – 10.30)

10.30 – 10.40 **Welcome, introductions, event objectives, CLNR project summary**
Jim Cardwell, Northern Powergrid

10.30 – 12.20 **Network technology**
Chaired by Chris Thompson, Northern Powergrid

Monitoring – how data capture leads to product optimisation
Julian Brown, Nortech

Energy storage – trials and tribulations of full procurement; is full procurement the way forward for trials and learning?
Ian Lloyd, Northern Powergrid

Real Time Thermal Ratings – tomorrow's training material; how do you introduce these concepts to people? (RTTR video)
Ian Lloyd, Northern Powergrid

Enhanced Automatic Voltage Control – power is simplicity
Dave Roberts, EA Technology

CLNR Grand Unified Scheme (GUS) Control System – what are the benefits and how can it be implemented?
Andrew Birch, EA Technology

Panel session – opportunity for Q&A and discussion

AGENDA (continued)

13.20 – 14.30 **Process**

Chaired by Andrew Spencer, Northern Powergrid

Network field trials – the art of effective design
Phil Taylor, Durham University

Extracting learning from the trials (VEEEG methodology)
Phil Taylor, Durham University

IPR and dissemination- challenge and complexity of management
Liz Sidebotham, Northern Powergrid

Panel session – opportunity for Q&A and discussion

14.50 – 16.00 **Outputs**

Chaired by Chris Thompson, Northern Powergrid

Customer and generation profiles - analysing today's consumers and suppliers
Peter Davison, Durham University

The network designer's toolkit (NPADDS)
Mike Lees, EA Technology

Social learning – the socio-technical approach
Harriet Bulkeley, Durham University

Panel session – opportunity for Q&A and discussion

16.00 – 16.30 **Summary and discussion of main issues. How do we embed learning into future CLNR and other LCNF projects, mainstream business and ED1?**

Jim Cardwell, Northern Powergrid

16.30 – 17.00 **Optional tour (4)** of Durham Energy Institute's state of the art laboratory

Appendix 4 – Foreground IPR

Product containing relevant foreground IP	LO	Primary creator
Test cell specification detailing the equipment to be installed, customer prerequisites, process summary and any tariff details for each customer test cell. • Test Cell 10a – Domestic Electric Hot Water Details • Test Cell 10b –White Goods SME Restricted Hours • Test Cell 11a – Domestic wet white goods Direct Control • Test Cell 11b - White Goods SME Direct Control	2	BG
Disaggregated load monitoring trial detailed design Detailed in supplier contracts and variations for disaggregated load monitoring	1	BG Passiv MicroWatt
Power Quality Monitoring trial design	1	EATL/BG
BG Domestic Smart Meter Data: TC1 Customer Consumption Profiles to end July 2012	1	BG
BG Domestic Data: PV, Heat pump and EV average power data to end of Sept 2012	1	BG
BG Domestic circuit monitoring data for pilot customers Oct/Nov 2012.	1	BG
CLNR British Gas Lessons Log	1 & 2	BG
Residential Online Survey	1	DEI
Residential Online Survey Results Data	1	BG
Off-Peak Saver 3 Rate Bill	2	BG
Off-Peak Saver 2 Rate Bill	2	BG
Passiv Systems CLNR Lessons Log	1 & 2	BG
Customer Facing Literature Economy 7 trials	1	BG
On-Line Expression of Interest Form - TC2	1	BG
Customer facing literature TC2	1	BG
BGB Technical solutions report	1 & 2	BG
Baseline Policies and Procedures: Identifying the gaps between a DNO document set (including referenced standards in a separate report) and the generic set expected for a low carbon network operator.	5	EATL
Baseline Key Knowledge Requirements: Identifying the knowledge gaps (per DNO staff groups) that will be required to be filled should the CLNR network technologies and new ways of working become business as usual.	5	EATL

Product containing relevant foreground IP	LO	Primary creator
Operational Procedures and Safety Rules: An initial report evaluating the criticality of required changes to operational documents for low carbon networks. Some critical documents will be amended during the remainder of the project	5	EATL
Power Quality Measurements: The initial phase of Power Quality impacts assessment considering the locations required for monitoring devices in relation to the test cells and items already installed.	5	EATL
DSR Design and Interface Specifications: A report including specifications and data exchange for the interfaces to aggregator and other DSR provider systems.	3	EATL
NPADDS Requirements Capture: The output of an initial design and consultation process between EA Technology and Northern Powergrid Senior Users for this CLNR Network Planning and Design Decision Support tool.	5	EATL
CLNR Network Technologies Demonstration Model: The realisation of a physical, scaled, transportable and interactive model with simple logic to explain the issues and possible smart solutions being investigated on the CLNR project.	5	EATL
DEI-CLNR-DC008-Survey Design	1,2	DEI
DEI-CLNR-DC016-Learning Outcomes Mind Map	All	DEI
Denwick Schematic Two Feeders	3	DEI
Distribution Network Voltage Control Using Energy Storage and Demand Side Response – Abstract	3	DEI
Integrating Electrical Energy Storage into Coordinated Voltage Control Scheme for Distribution Networks – Abstract	3	DEI

Appendix 5 – Progress in Recruitment and Data recorded

Test cell	Customer group	Original planned customer numbers	Forecast customer numbers	Customers recruited	Customers live	12-months data available	Comments
1a	Domestic – basic monitoring profile	9,000	9,000	8,909	8,909	Jan 2013	This is the final number of recruits
1b	SME – basic monitoring profile	2,250	2,250	1,800	1,800	Jan 2013	Currently looking to top up with an additional 450 customer records
2a	Domestic – enhanced monitoring profile	600	150	172	3	Feb 2014	Installation programme just initiated – recruitment closed
2b	SME – enhanced monitoring profile	150	150	88	45	Jan 2014	Installation programme underway
3	Domestic heat pumps – flat rate tariff	600	350	305	65	Mar 2014	Heat pump and monitoring installation programme underway – recruitment still open
4	Domestic micro-chp – flat rate tariff	20	20	13	3	Feb 2014	Micro-chp and monitoring installation programme underway – recruitment still open
5	Domestic PV	150	150	150	146	Dec 2013	Recruitment closed
6	Domestic electric vehicles	150	25	4	4	Mar 2014	Alternative routes to recruitment being pursued
7	Understand impact of April 2012 tariff reform	14,000	14,000	14,000	14,000	-	Completed
8	Profiling for generation under smart tariffs	230	230	230	230	-	Completed
9a	Domestic time of use tariff	600	600	683	683	Aug 2013	Recruitment closed – test cell over-populated

Test cell	Customer group	Original planned customer numbers	Forecast customer numbers	Customers recruited	Customers live	12-months data available	Comments
9b	SME time of use tariff	150	150	51	42	Jan 2014	Recruitment closed – remaining customers to be transferred to time of use tariff
10a (RH)	Domestic electric hot water (restricted hours trial)	300	-	-	-	-	Test cell disbanded
10a (HW)	Domestic electric hot water enhanced monitoring	-	25	13	0	Jan 2014	Recruitment still open
10a (WWG)	Domestic wet white goods (restricted hours trial)	300	75	0	0	Mar 2014	Recruitment to be initiated
10b	SME restricted hours	150	3	2	2	Nov 2013	Recruitment closed – proposition unsuitable for customers
11a	Domestic electric hot water (direct control trial)	300	-	-	-	-	Test cell disbanded
11a (HW + SH)	Electric hot water & storage heating enhanced monitoring	-	100	57	2	Jan 2014	Recruitment still open
11a (WWG)	Domestic wet white goods (direct control trial)	300	75	0	0	Mar 2014	Recruitment to be initiated
11b	SME direct control	150	0	0	0	-	Recruitment closed – proposition unsuitable for customers
12	Domestic heat pumps (time of use)	600	50	77	8	Feb 2014	Recruitment and installation of monitoring and heat pumps underway
13	Domestic heat pumps (restricted hours)	150	5	1	0	Mar 2014	Recruits to be transferred from test cell 12
14	Domestic heat pumps (direct control)	150	50	17	2	Mar 2014	Recruitment and installation of monitoring and heat pumps underway

Test cell	Customer group	Original planned customer numbers	Forecast customer numbers	Customers recruited	Customers live	12-months data available	Comments
15	Electric vehicles (time of use trial)	50	-	-	-	-	Test cell disbanded
16	Electric vehicles (restricted hours trial)	50	-	-	-	-	Test cell disbanded
17	Electric vehicles (direct control trial)	50	-	-	-	-	Test cell disbanded
18 & 19	Ancillary services (fast reserve and voltage support) provision	15	15	3	-	Oct 2013	Winter 2011/12 trials concluded. Recruitment for 2013 trials underway.
20 (Auto)	Domestic PV – within premises balancing (automatic)	300	150	99	92	Dec 2013	Recruitment still open
20 (IHD)	Domestic PV – within premises balancing (manual – in-home display)	300	150	150	142	Jan 2014	Recruitment still open