electricity north west
Bringing energy to your door

C2C

Capacity to Customers
Project Progress Report (PPR)

Version 1
19 December 2014

VERSION HISTORY

Version	Date	Author	Status	Comments
1	19 December 2014	Paul Turner	1st issue	

APPROVAL

Name	Role	Signature & date
Mike Kay	Networks Strategy and Technical Support Director	Mike Kay Digitally signed by Mike Kay DN: cn=Mike Kay, o=Electricity North West, ou=Network Strategy, email=mkay@iee.org, c=GB Date: 2014.12.18 12:27:59 Z
Steve Cox	Head of Engineering	Mr Stephen Cox Digitally signed by Mr Stephen Cox DN: c=GB - UNITED KINGDOM, email=steve.cox@enwl.co.uk, o=Electricity North West Ltd, ou=Network Strategy, cn=Mr Stephen Cox Date: 2014.12.19 09:20:47 Z
Lynne Fulton	Head of Business Performance	Lynne Fulton Digitally signed by Lynne Fulton CN=Lynne Fulton C=GB - UNITED KINGDOM O=Electricity North West E=lynne.fulton@enwl.co.uk

CONTENTS

GLOSSARY OF TERMS

Abbreviation	Term
CEP	Customer Engagement Plan
CRMS	Control Room Management System
C_2C	Capacity to Customers
DPS	Data Protection Statement
DSR	Demand Side Response
IC_2C	C2C circuit runs interconnected with others
I&C	Industrial & Commercial
MPAN	Meter Point Administration Number
SDRC	Successful Delivery Reward Criteria
SDRC output	Discrete evidence of attainment or part attainment of an SDRC as defined in the Project Direction
RC_2C	C2C circuit runs as a radial only
RTU	Remote Terminal Unit
NMS	Network Management System
GE PoF	GE PowerOn Fusion Network Management System
GSM	Global System for Mobile Communication (GSM)

All other definitions shown starting with a capital letter are as per Low Carbon Networks Fund Governance Document v.6

1 EXECUTIVE SUMARY

The C_2C Project was authorised to commence in January 2012 and is due to complete in March 2015. The aim of the Project is to test new technology, network operational practices (ie closed HV rings), the customer experience of being connected to a closed ring and commercial demand response contracts that will allow Electricity North West to increase the loadings on a selection of Trial circuits representing approximately 10% of our HV network without resorting to conventional network reinforcement. In other words to 'release' inherent spare capacity in the HV system in order to accommodate the future forecast increases in demand whilst avoiding (or deferring) the cost and environmental impacts that are associated with traditional network reinforcement. The Project consists of customer and commercial; technology; and learning and dissemination Workstreams.

The Project has developed and is now trialling new demand response contracts that will allow Electricity North West to manage the import or export capacity of either existing or new connections customers on the Trial circuits under fault or abnormal system conditions. Existing customers are receiving regular monthly payments in exchange for the managed contract, whereas new connections customers are being offered the option to sign up to a connection contract with demand response obligations in exchange for a reduced connection / reinforcement charge.

In the event that a fault occurs on or adjacent to the HV network feeding such a customer, the contract will allow Electricity North West to manage all or part of their import or export capacity, if required by the network, to enable Electricity North West to restore customers' supplies in as short a time as possible. It is envisaged that many future customers may opt for part of their demand to be managed in this manner in exchange for reduced connection charges.

The Project commenced the live Trial phase in April 2013 and this will continue until December 2014 (subject to an extension request). There has been considerable customer engagement throughout the Project both in preparation for Trial go-live and since go-live. This will continue throughout the Trial period.

The Project actual costs to date are £7.958m and the estimated at completion costs is now £8.740m, which is £1.535m favourable to Project Budget (including contingency).

Progress to date

This report is the sixth Project Progress Report and covers the period June 2014 to November 2014 inclusive. The Project is on track and key highlights to date are;

Ongoing customer engagement element of the project is progressing well.

- We have performed 702 post fault customer surveys on C_2C circuits and early findings demonstrate that where short duration interruptions (SDIs) are detected; this enhances the power quality perception of customers.
- We have performed 656 power quality monitoring surveys with customers on both C_2C and non C_2C circuits and overall, customers have not suffered any material changes in their power supply quality under C_2C operating conditions.

The above interviews have been completed throughout the trial to allow for qualitative analysis to be undertaken. An overview of current findings can be found in the lessons learned section of this report.

We have also performed 15 surveys of I&C customers who have either accepted or rejected a C_2C contract in order to enhance our understanding of the motives and barriers to take-up.

Recruitment of new connections customers has been challenging

This element of the project has been adversely affected by the economic downturn resulting in lower overall system demand and hence fewer qualifying applications requiring reinforcement. This situation has been exacerbated by other LCNF work which has progressed into business as usual increasing existing network capacity. As a consequence we have been able to offer fewer C_2C managed connection agreements than originally envisage to new connections customers as these only benefit customers when reinforcement is required.

A request for a 3 month extension to the project to enable the recruitment of ten new connections has been made to Ofgem. This request has been endorsed by university project partners and other DNOs and will have a positive impact on the learning generated if approved. We have currently signed eight new connection contracts and have 4 new connection opportunities that we are pursuing. We are continuously monitoring this element of the project and fully expect to sign the all ten customers required by the SDRC within the trial extension period.

Recruitment of existing customers is complete

- We have achieved our SDRC relating to purchasing a minimum of ten existing customer contracts.
- We have purchased 10 contracts and generated learning using 3 routes to market, namely direct, via an agent and via an aggregator.
- During the current reporting period we have conducted a proof of concept Trial aimed at demonstrating a low cost method of a DNO initiating a trip of a circuit breaker controlled by an aggregator. This is essential to enable the third route to market, namely contracts purchased via an aggregator.

During the reporting period the Project has delivered 4 SDRC outputs, these are detailed below and in section 5.

Academic Research is nearing completion

The University of Strathclyde have quantified the technical performance of C_2C network operation on typical electrical distribution systems.

- The simulation studies of actual C_2C trial circuits have shown that on average C_2C operation can release up to approximately a 76% increase in demand and a 225% increase in DG capacity.
- The maximum levels of demand released by C_2C operation leads to annual HV network losses of approximately 0.3% higher than the equivalent losses assumed from conventional reinforcement of the radial networks.
- Power quality measurements have been analysed and it has been found that C_2C operation has no notable impact on power quality.
- It has been demonstrated that C_2C operation is unlikely to exceed HV design fault level ratings or restrict the future adoption of C_2C.

The University of Manchester is conducting an economic benefits analysis to investigate whether or not the C_2C method or combinations of underlying solutions are economically favourable, as well as understanding the key factors that engender or constrain value creation. The methodology used also assesses the relative economic value of the C_2C method's two permutations, namely the Radial C_2C method (RC_2C) and the Interconnected C_2C (IC_2C). The Radial C_2C method is connecting managed customers to existing HV radial feeders, whereas the Interconnected C_2C method is connecting managed customers to interconnected HV radial feeders.

Analyses conducted for different scenarios and network types highlight the following:

- The C_2C method offers an efficient means to defer or even avoid costly line reinforcements and substation upgrades under most conditions.
- From the economic perspective, the C_2C method (particularly the RC_2C permutation) is more likely to outperform traditional interventions when demand growth is modest (or uncertain), as it can lead to significant capital savings from investment avoidance.
- The IC_2C method can be attractive from the power losses perspective, particularly in scenarios where demand is expected to increase significantly. In such scenarios, the IC_2C can lead to both significant capital savings (from investment deferral) and power losses reductions (from combinations of the IC_2C and reinforcements).
- The RC_2C method tends to outperform the IC_2C method when only investment costs are considered. However, the IC_2C method tends to be a better option when both investment and social costs (ie, power losses and reliability) are included in the CBA.
- The RC_2C and IC_2C methods are likely to lead to higher social costs than traditional reinforcements. However, the additional power losses associated with the RC_2C and IC_2C can become marginal subject to increased penetration of Distributed Generation (DG).

Tyndall Centre for Climate Change Research at the University of Manchester is conducting studies to understand the carbon impact of the C_2C project.

Table 1.1 Most significant SDRC delivered during the reporting period

Milestone	Workstream	Completion date
Submit project progress report number five to Ofgem	Dissemination	Jun-14
Publication of white paper number five	Dissemination	Jun-14
Present to fourth industry conference (2014 LCN Annual Conference)	Dissemination	Nov - 14

During the next reporting period the Project will seek to complete negotiations of at least ten post-fault demand response contracts with new customers, complete analysis work with academic partner, complete close down report and continue to disseminate learning on an ongoing basis.

Summary of key risks

There is one risk associated with the achievement of a Project SDRC or maintaining consistency with the Full Submission. This risk is summarised below and has been managed by requesting an extension. This will enable all 10 new customers to be signed and result in improved learning from this activity.

Risk description	Category
Low economic activity and reduced system maximum demand may affect participation for new connections customers.	Recruitment

Summary of key learning outcomes delivered in the period

A detailed description of the Project's learning outcomes can be found in section 6, the areas where learning has emerged are summarised below:

- Engagement with customers.
- Purchasing DSR from new connection customers.
- Academic analyses of power quality and capacity released due to C_2C arrangement.

Third Party dissemination activities

Event	Contribution	Date
Various electronic newsletters	Published	Various
UoS- Increasing Distribution Network Capacity using Automation to Reduce Carbon Impact', IET Protection Seminar, Birmingham	Presented	October 2014
Smart Grid Forum (WS6) Consumer Demand Side Response Day	Presented	October 2014
Smart Grid Forum – Workstream 7	Participated	October 2014
IEEE ISGT Europe, Istanbul	Presented	October 2014
Northern Ireland Electricity visit	Presented	November 2014
WPD - Distribution networks: A Balancing Act	Participated	November 2014

Internal dissemination activities.

- Company-wide briefings via our intranet and internal Newswire magazine.

2 PROJECT MANAGERS' REPORT

2.1 General Project Management

The most significant Project management activities undertaken during the reporting period are listed below:

- Management of Project resources.
- Project monitoring and control.
- Internal and external stakeholder awareness.

During this reporting period the Project emphasis has continued to focus on Trial implementation and academic analysis of the C_2C configuration. The key activities of the Project team have been the purchase of managed agreements from new connections customers, customer engagement, data collections and analysis. Continuous internal stakeholder engagement has taken place in order to embed the Trial processes and obtain feedback from those involved.

During the next reporting period significant Project management activities will be:

- Completion of internal & external engagement.
- Completion of Project closedown report.

There are no Project management risks or issues that are associated with delivery of a Project SDRC or maintaining consistency with the Full Submission subject to the Project extension currently with Ofgem for approval.

2.2 Technology Workstream

The most significant Technology Workstream activities during the reporting period are listed below:

- Installation of remote control devices at Trial participants' premises.
- Management of data retrieved from Trial networks.

- Continued work with University Partners on losses, power quality, carbon and economic benefit analysis work with the Universities of Manchester & Strathclyde

All SDRC that are associated with the above activities are complete or on track.

During the next reporting period, the Technology Workstream's significant activities will be:

- Completion of losses, power quality, carbon and economic benefit analysis work with the academic Partners.
- Installation of remote control equipment at customers' premises and other locations as appropriate as and when Trial participants are secured.

There are no Technical Workstream risks or issues that are associated with delivery of a Project SDRC or maintaining consistency with the Full Submission.

2.3 Customer and Commercial Workstream

The most significant Customer and Commercial Workstream activities during the reporting period are listed below:

- Continued engagement with existing I&C customers.
- Continued direct engagement with new I&C demand and generator customers to secure new connections Trial participants.
- Customer seminars and briefings.
- Ongoing power quality monitoring customer surveys throughout the Trial to obtain feedback from customers connected to Trial circuits (test group) and customers not on trial circuits (control group) to allow for comparisons to be made.
- Ongoing post fault surveys to monitor the effects of the C_2C trial on customers who have experienced a fault.

All SDRCs that are associated with the above activities are complete or on track. As stated in the executive summary the activity of securing ten managed connection agreements has been affected by low economic activity and reduced system maximum demand due to a continuation of the economic recession in the North West region. This risk is described in full in section four of this document.

During the next reporting period the Customer and Commercial Workstreams' significant activities will be:

- Continued direct engagement with new I&C demand and generator customers to secure new connections Trial participants.
- Analysis of power quality monitoring and post fault customer surveys to monitor the effects of the C_2C trial on customers.

3 CONSISTENCY WITH FULL SUBMISSION

During the previous reporting period Ofgem have been asked to approve a change request associated with the project. This change was in relation to SDRC 9.7.i which concerns signing up 10 new connection customers to participate in the trial. This SDRC should have been completed by September 2014 but was not due to current low economic activity and reduced system demands. The extension of SDRC 9.7.1.i has the knock on effect of extending 4 other SDRCs in the table below so that the learning gained from signing up the full 10 customers is fully disseminated and a full set of capability tests is completed.

Milestone	Planned date	Requested revised date
9.7.1.i C_2C managed connections contracts in place	Sep-14	March-15
9.3.8 Various engagement programs continued through until Dec 2014, using various channels including website and e-mail.	Dec-14	March-15
9.6.3 Present to industry conference number five (Electricity North West knowledge sharing event)	Dec-14	March-15
9.4 Demand response capability test completed	Dec-14	March-15
9.6.6 Closedown report submitted to Ofgem	Dec-14	March-15

- With the exception of the above change the Project is being undertaken in accordance with the Full Submission.

4 RISK MANAGEMENT

4.1 Risks and issues experienced during reporting period

Recruitment Risks

There is currently one recruitment risks that is associated with the achievement of the Project SDRCs or maintaining consistency with the Full Submission.

Low economic activity and reduced system maximum demand may affect participation for new connections customers (R023) - Status: Open – Likelihood: Low, Impact: Significant

Risk: There is a risk that we may not secure ten demand response contracts with new customers, leading to failure to achieve a Project SDRC, because of lower than anticipated economic activity and reduced system maximum demand in the North West region.

Action plan:

We have performed a number of actions to mitigate this risk. The first proactive action was taken during Trial circuit selection activity where connections market activity was a key criterion for assessing suitability of the circuit for inclusion in the Trial. Since December 2012 we have increased engagement with developers to reinforce and cement awareness of the opportunities that may exist to obtain lower cost connection quotations. We have been closely monitoring new connections applications on the C_2C circuits. In addition to this we have also performed a number of other actions such as:

1. Review of all non C_2C applications that have expired or are about to expire. There may be opportunities to re-design and re-quote based on the C_2C design principles to customers who have not accepted on the basis of the original quote being too high.
2. Review of all accepted 'non C_2C quotations' that have gone into construction but not yet started on site. Some of these may be eligible for and benefit from being re-designed and re-quoted based on the C_2C design principles. In all cases this would be by agreement with the customer. And subject to an eligibility test (ie in the trial area).

A request for a 3 month extension to the project to enable the recruitment of ten new connections has been made to Ofgem. This request has been endorsed by university project partners and other DNO's and will have a positive impact on the learning generated if approved. We have currently signed eight new connection contracts and have 4 new

connection opportunities that we are pursuing. We are continuously monitoring this element of the project and fully expect to sign the all ten customers required by the SDRC within the trial extension period

Procurement, Installation and Other

Risks

There are currently no Procurement, Installation or Other risks that affect our ability to deliver the Project as described in the Full Submission.

4.2 Risks that existed at time of documenting the Project Full Submission

The narrative below refers to risks that existed at time of submission and were detailed in Appendix 2 of the Full Submission.

Recruitment Risks

No recruitment risks were detailed in Appendix 2 of the Full Submission.

Procurement Risks

Risk 8 – Project Partners walk away once Project is won - Status: Controlled

We have signed contracts with GE Energy, PB Power, npower and our University Partners who are all are actively engaged in the Project. As described in section three of this report, Enernoc has declined to actively participate in the purchase of C_2C DSR agreements for strategic commercial reasons. We continue to work with our Partners in order to complete their work packages and prepare learning and dissemination material for Project Closedown.

Installation Risks

Risk 1: Risk that internal Operations team will not be able to support installation of automated devices - Status: Controlled

The majority of installation work has now been completed. The only installation work remaining is the installation of equipment at Trial customers' premises as and when they sign contracts. Our Technology Workstream is liaising directly with the installation resource and no issues are foreseen over the remainder of the Project.

Risk 6 – Network equipment cost overruns - Status: Controlled

This activity has been completed within budget.

Other Risks

Risk 2: Risk that key personnel will not be available to deliver the Project - Status: Controlled

The Project delivery team has been recruited and are part of the same department as the bid development team, which supported the delivery team during the mobilisation stage of the Project. The Project is now past its most intensive period and is sufficiently resourced to deliver the remainder of the Project.

Risk 3: Risk of problems with the financial control of the Project because of the new requirement for a separate bank account - Status: Controlled

The Project Bank Account has been set up and monthly processes have been put in place to review receipt and payments on a monthly basis.

Risk 4: Failure to achieve low carbon saving - Status: Open – Likelihood: Moderate, Impact: Significant

This aspect of the Project is being investigated by our Partner, Tyndall Centre (for Climate Change) at University of Manchester. Their approach is similar to that used by the Kyoto Protocols' Clean Development Mechanism. A baseline scenario has been constructed to represent business as usual capacity release through traditional reinforcement. A Life Cycle Assessment (LCA) will be performed for the assets used in the network reinforcement, totalling the greenhouse emissions embodied in their manufacture, transport, installation and disposal. The carbon impact from the assets and the operations of the network under the C_2C configuration will then be compared to this baseline and summed across defined time periods.

Action plan: Complete analysis and publish findings via standalone publications and through Project learning and dissemination materials.

Risk 5: Poor Project management - Status: Controlled

The Project team has been recruited. Weekly and monthly Project governance meeting have been established and implemented. These include monthly updates to the sponsoring director.

Risk 7 – Payment to customer cost overruns - Status: Controlled – Likelihood: Moderate, Impact: Low

This activity has been completed within budget

5 SUCCESSFUL DELIVERY REWARD CRITERIA

During the reporting period, six planned SDRC were delivered. These are detailed in table 5.1 below.

Table 5.1 SDRC delivered in reporting period

Milestone	Planned date	Forecast date	Comments
Submit project progress report number five to Ofgem	Jun-14	Jun-14	Completed
Publication of white paper number five	Jun-14	Jun-14	Completed
Present to LCN Fund Annual Conference by 2014	Dec-14	Oct-14	Completed
C_2C managed connections contracts in place	Sep-14	Sep-14	Completed

The SDRC planned for the next reporting period can be seen in table 5.2 below.

Table 5.2 SDRC look ahead

Milestone	Planned date	Forecast date	Comments
Publication of white paper number six	Dec-14	Dec-14	Completed
C_2C managed connections contracts in place	Mar-15*	Mar-15	On track
Present to industry conference number five (Electricity North West knowledge sharing event)	Mar-15*	Jan-15	On track
Demand response capability test completed	Mar-15*	Mar-15	On track
Closedown report submitted to Ofgem	Mar-15*	Mar-15	On track

* Subject to Project extension request

6 LEARNING OUTCOMES

We have established a Project website which is used as a repository for sharing Project learning to interested stakeholders. The learning outcomes during the period are described below.

Lesson 1: Engagement with customers (Power Quality Monitoring initial findings)

Background: Surveys have been conducted to monitor the effects of the Trial on customers in three areas:

1. Measuring customer perceptions of their power quality and reliability ie fault frequency, duration, dips and spikes throughout the trial period.
2. Comparing the perceptions of those customers who are not on C_2C circuits (control) to those that are (test).
3. Comparing the perceptions of both test and control customers to reality by comparing customer survey data with actual fault frequency and duration.

In total 656 interviews have been completed, predominantly with domestic customers. The results of these surveys have been weighted to ensure that the control and test groups have a matched customer profile allowing comparisons to be made.

Lessons learned

1. Customers have not perceived any material changes in their power supply quality as a result of C_2C operating conditions.
2. Power quality perception is consistent across both test and control groups.
3. Where SDIs occur and are noticed by customers, there is convincing evidence that this enhances power quality perception.
4. Faults are not having an adverse effect on power quality perception even amongst customers who we know have experienced a fault. The net change in perception on trial circuits is generally positive, meaning it would not be a concern to roll out as business as usual.

Further comments

These initial findings suggest that for trial customers, the introduction of C_2C improves perceptions of their experience of faults. To find out if these lower levels of observation are a result of fewer faults actually taking place or as a result of customers finding them more difficult to detect, we have begun cross-referencing fault data with customer perception. Our initial findings show that the number of domestic customers claiming to experience faults roughly matches the number of actual faults. We have further work to do to cross-reference real fault data to allow for further qualitative analysis to be undertaken and to validate our findings.

Lesson 2: Purchasing DSR from new connection/ additional load customers

Background:

Section 9.7 of the Full Submission document committed to enter into managed agreements with demand and/or generation customers or their agents, at least ten of which from connections customers during the trial period from April 2013 to September 2014.

To achieve this it was planned to support the existing connections business with dedicated C_2C connections resource in order to manage the marketing, customer engagement and customer relations with new I&C customers and developers seeking connection to a HV or EHV trial circuit. The C_2C solution would mitigate the requirement to reinforce the network (as per standard design), however the restoration of the customer's supply may be managed during a fault event.

The C_2C connections team have reviewed 760 applications from I&C and generator customers whose site was on/near a trial circuit. From these, 76 applications have required reinforcement (or connected to an alternative circuit to avoid the requirement to reinforce the network).

To date we have offered managed agreements to 16 customers, 8 have accepted, 6 declined the C_2C offer, and two are still considering their offers.

As highlighted in chapter four there has been a lower than anticipated number of opportunities throughout the Trial period, this is due to a reduction in the maximum demand of the primary transformers supplying the trial circuits of 6.6%, from 2009 to 2013. To put this in context, this could equate to 300kVA to 495kVA additional available capacity per HV circuit depending on circuit voltage. When combined to form a ring, this could result in possibly two connections being made to the network without the need for reinforcement that previously would have triggered reinforcement. Considering there are over 150 closed rings on the trial, this means that approximately 150[1] connections offers could now be made without the need for reinforcement that, based on 2010 demand would have triggered reinforcement.

Lessons learned

1. **Customer negotiations - getting to speak to the decision makers -** Though we were aware that the managed agreement had to be entered into by the end user, we did not fully anticipate the complexity of the work involved in articulating the C_2C proposition to the key decision makers within the end user organisation. We now know that in most cases the original requester does not have the decision making powers to accept the C_2C connection and that we need to be present the C_2C concept and the proposed C_2C connection arrangements several times as the connection offer rises through the organisation to the key decision maker. A considerable amount of effort has been invested in briefing and re-briefing customer

[1] Based on an average HV load applied for of 764kVA since Jan 2011.

employees or agents. This has resulted in a much longer negotiation period than anticipated.

Agents acting on behalf of customers (eg IDNOs, ICPs, consultants, developers) often did not have an incentive to seek a C_2C solution. C_2C only benefits the end user, and not a customer's agent. On occasion this made it difficult to negotiate beyond the customers' agent and actually reach the key decision maker. We envisaged this was a potential issue, and in December 2012 we invited the key players in Electricity North West's connections market to an event, to introduce them to the C_2C concept. The event presented the benefits of the trial to our customers in two ways. It outlined the potential of a cost saving on a new or additional load connection, as well as the larger benefits to the future of the UK electricity industry. To encourage agents to seek a C_2C solution, we reminded them of the competition in Electricity North West's connections market, and suggested that it would be in their best interest to seek a C_2C solution when offered, with their customers to mitigate the risk of being outbid by a competitor.

2. **Perceived impact of C_2C on customers with process operations -** For some customers with a manufacturing process, a failure of supply can often lead to the loss of revenue due to a break in their production. Process orientated customers were conscious that operating our network in a closed ring configuration, would potentially increase the number of fault events on their circuit. Some customers perceived that a disruption to their power supply, albeit of less than 3 minutes, could still result in the loss of production. For example, a customer may have lost one production day every three years prior to C_2C, and now may experience two lost production cycles. This presented a barrier to acceptance in some cases. Interestingly when questioned about their existing business continuity arrangements some customers said that they were nervous about the impact of increased short duration interruptions but did not have arrangements in place that reflected their sensitivity to loss of supply.

3. **Managing customer's load -** When negotiating the prospect of a managed agreement with customers, a number had concerns about Electricity North West managing the physical disconnection of their managed load. Some customers have requested an option to be allowed to provide a given demand response within a certain timescale, instead of a pre-defined load control device being tripped automatically. In some instances we are willing to accept this, in particular where, as a last resort, there is a load control device that is controlled by Electricity North West that can be tripped should the customer not provide the agreed demand response in the agreed timescale.

Lesson 4: Analysing the effect of C_2C

Background: A key aspect of the Trial is the technical, economic and environmental assessment of C_2C. Our two academic partners; The University of Strathclyde and The University of Manchester are currently completing this analysis.

The University of Strathclyde work-package is validating the effect of new C_2C network configurations at distribution level and addition of post fault demand response loads on: (i) ability to release network capacity; (ii) electrical losses; and (iii) power quality. This has been achieved using simulation models based upon actual system data and through the analysis of power quality monitoring data gathered from a representative proportion of the C_2C trial circuits. The results produced determine the theoretical maximum limits and effects of C_2C operation on the aforementioned criteria. Particular attention is given to quantifying the benefits of interconnected (closed-ring) HV network operation over conventional radial (open-ring) operation.

The University of Manchester is conducting an economic benefits analysis to investigate whether or not the C_2C method or combinations of underlying solutions are economically

favourable, as well as understanding the key factors that engender or constrain value creation.

A deterministic scenario and optimisation based framework consistent with Ofgem's RIIO-ED1 CBA has been developed. It can identify optimal asset build strategies that may recommend implementing traditional reinforcements and C_2C interventions independently (ie, a reinforcement can be avoided via a C_2C intervention) or in combination (ie, some benefits can be gained by implementing both C_2C and reinforcement solutions). The methodology used also assesses the relative economic value of the C_2C method's two permutations, namely the Radial C_2C method (RC_2C) and the Interconnected C_2C (IC_2C).

Detailed sensitivity analyses have been performed, which highlight the impact of a wide range of different assumptions on the expected performance of implementing the C_2C method in 36 C_2C Trial networks.

The environmental work-package is investigating the resultant carbon impact from the assets and the operations of the network under the proposed C_2C configuration.

Lesson Learned:

1. The simulation studies of actual C_2C trial circuits have shown that C_2C operation can release significant demand and DG capacity. On average, C_2C operation can achieve up to approximately a 76% increase in demand and a 225% increase in DG, compared with defined base case scenarios. However, the results depend significantly on the individual circuit topologies, the ratings of circuit sections, and load or DG locations
2. The maximum levels of demand released by C_2C operation leads to annual HV network losses of approximately 1%, as a percentage of demand. This is approximately 0.3% higher than the equivalent losses assumed from conventional reinforcement of the radial networks.
3. Power quality measurements from several locations throughout the Electricity North West network and spanning a significant period of the duration of the C_2C trial have been analysed to compare the effects of Radial C_2C operation and Interconnected C_2C operation. Extensive validation of the monitoring data has been performed to ensure that the comparisons are sound. C_2C operation is likely to have no notable impact on power quality.
4. It has been demonstrated that C_2C operation – even at the most extreme levels of released demand and DG – is unlikely to exceed HV design fault level ratings or restrict the future adoption of C_2C.
5. Economic: Using the enhanced CBA framework, results of the preliminary analyses conducted for different scenarios and network types indicate that the C_2C method can be a cost effective alternative to traditional reinforcement practices as it can result in significant network investment and social costs reductions. The solution has a higher potential to be economically attractive when: (i) when costly reinforcements can be deferred or averted (ii) social costs are considered (iii) demand growth is highly uncertain.
6. The C_2C method can be an attractive means to defer or even avoid costly line reinforcements and substation upgrades under most conditions.
7. From the economic perspective, the C_2C method (particularly the RC_2C permutation) is more likely to outperform traditional interventions when demand growth is modest (or uncertain), as it can lead to significant capital savings from investment avoidance.
8. The IC_2C method can be attractive from the power losses perspective, particularly in scenarios where demand is expected to increase significantly. In such scenarios, the IC_2C can lead to both significant capital savings (from investment deferral) and power losses reductions (from combinations of the IC_2C and reinforcements).
9. The RC_2C method tends to outperform the IC_2C method when only investment costs are considered. However, the IC_2C method tends to be a better option when both investment and social costs are internalised.
10. The RC_2C and IC_2C method is likely to lead to higher social costs (ie, higher power losses) than traditional reinforcements. However, the additional power losses associated

with the RC_2C can become marginal subject to increased penetration of Distributed Generation (DG).

Lesson 5: Accommodating DSR in ER P2-6

Background: We have conducted a consultation to gather views on the ability of Engineering Recommendation P2/6 (ER P2/6) "Security of Supply" to recognize customer load management and demand side response (collectively termed DSR) and the requirement or otherwise for modification of ER P2/6 in the short term to explicitly include the effects of DSR. In December 2012 Electricity North West was granted derogation from P2/6 relating to the C_2C circuits for the duration of the Trial.

The consultation format included network simulations to develop scenarios to be used in workshops and consultation documents. Internal workshops were initially held with selected staff with varying levels of P2/6 knowledge. The staff were questioned and provided their views on scenarios. A consultation document was then developed as an output from the internal workshop and opened to third parties. External workshops involving other DNOs, IDNOs and NGET took place and attendees gave their view on various scenarios.

Lesson learned:

Our work indicates that there is a general consensus among network operators that P2/6 does not preclude the use of n-1 DSR to maintain compliance but policy changes should be made to make this clearer. Our view was that ETR130 should be changed in the short term to enable DSR to be used at an appropriate level. Our work indicates that there was support for an update to ETR130 to clarify the use of DSR and the management of system intact load levels in the short term. Subsequent to the consultation process we issued a recommendation report. This report underwent revision due to further discussions with DNOs regarding the question of whether DSR should be accounted for in Group Demand or Network Capacity. The proposed changes enable each DNO to select the Group Demand option or Network Capacity as long as this selection is justified. The changes to ETR130 have been ratified by the GB distribution Code Review Panel.

Business case update

We are not aware of any developments that have taken place since the issue of the Project Direction that affect the business case for the Project.

7 PROGRESS AGAINST BUDGET

The original Project Budget as defined in the Project Direction is shown in Appendix A.

Prior to the acceptance of the Project Direction we discussed with Ofgem the re-categorisation of expenditure as our understanding of delivery methods had changed during the development of the Project initiation documentation. For example, we proposed to change our delivery approach by using our own labour for some activities rather than contractors. We accepted the Project Direction and agreed to inform Ofgem of the proposed changes within the Project Progress Report process. Appendix B details the proposed re-categorisation.

Ofgem has approved this request and agreed that moving forward we should report expenditure in relation to the re-based Project Budget.

Actual spend to date compared to re-based Project Budget is summarised in table 8.1 below. The report includes expenditure up to and including 30 November 2014. Detailed projected expenditure at Project activity level can be found in Appendix C.

The impact on the project costs due to the requested project extension has been included in the forecasted budget.

Table 8.1

£'000s Excluding Partner Funding Ofgem Cost Category	Spend to date Actual	Budget[1]	Variance	Total Project Forecast	Budget[1]	Variance
Summary						
Labour	1,390	1,607	217	1,499	1,755	256
Equipment	2,625	3,077	452	2,625	3,078	452
Contractors	2,486	2,953	467	2,891	3,012	121
IT	610	740	129	610	740	129
IPR Costs	0	0	0	0	0	0
Travel & Expenses	0	0	0	0	0	0
Payments to users	238	280	43	245	300	55
Contingency	282	816	533	435	947	511
Decommissioning	0	0	0	0	0	0
Other	326	410	84	434	445	11
Total Costs	**7,958**	**9,883**	**1,925**	**8,740**	**10,275**	**1,535**

Note 1: Re-based Project Budget as agreed by Ofgem on 24 January 2013

The actual spend to date is £7.958m, £1.9m favourable to Project Budget to date. The estimated at completion costs is forecast to be £8.7m, £1.5m favourable to Project Budget.

The current position shows the most significant contribution to this outperformance to date is due to £0.6m of efficiencies regarding remote control installation (£0.3m of this due to scope reduction[2]), £0.1m IT efficiencies and £0.5m of efficiencies against contingency. There is also a £0.12m out performance of the connections design budget. Our estimated at completion forecast currently reflects these efficiencies.

8 BANK ACCOUNT

The Project bank statement is shown in Appendix D. The statement contains all receipts and payments associated with the Project up to the end of November 2014.

9 INTELLECTUAL PROPERTY RIGHTS (IPR)

Electricity North West is following the default IPR arrangements. We have considered our IPR approach to current period Project deliverables and concluded the default IPR arrangements apply.

10 OTHER

There is no other information at this time that would be of use to Ofgem in understanding the progress of the Project and performance against the SDRC.

[2] The Project Budget assumed the funding for the installation of 540 remote control units, in reality the Project was required to fund the installation of 489 units due to 51 units overlapping with, and being funded by our Quality of Supply investment programme.

11 ACCURACY ASSURANCE STATEMENT

This document has been reviewed by a number of key business stakeholders. The Project team and select members of the C_2C Project Steering Group, including the lead member of the bid development team have reviewed the report to ensure its accuracy. The narrative has also been peer reviewed by the Electricity North West Future Networks Manager and the Electricity North West Networks Strategy and Technical Support Director.

The financial information has been produced by the C_2C Project Manager and the Projects' finance representative who review all financial postings to the Project each month in order to ensure postings have been correctly allocated to the appropriate Project activity. The financial information has also been peer reviewed by the Electricity North West Distribution Head of Business Performance. Issue of the document has been approved by the Networks Strategy & Technical Support Director.

APPENDIX A –PROJECT BUDGET

£000's Excluding Partner Funding Ofgem Cost Category	
Labour	**2,512**
Monitoring Equipment Installation - Labour	22
Business input into specs and testing & CIO System Design Approval	20
Connections – Clerical	65
Connections - Customer Relationship Management	241
Dissemination - ENWL & Customer engagement via email & training	28
Implementation of PowerOn Fusion	709
Maintenance & Support for PowerOn Fusion	187
Project Management - GE	351
Project Management - ENWL	790
Involvement in developing Future Network Planning/Operational Standard	15
Circuit Selection	32
Developing Future Network Planning/Operational Standard	53
Equipment	**3,078**
Publicity Materials - Informational Pamphlets & postage & packaging	18
Remote Control Installation - Plant	1,954
Monitoring Equipment Installation - Plant	112
Remote Control Installation - Materials	563
Commissioning SCADA link to Remote Control Devices	31
Delivery and configuration of GE IT hardware and software	399
Contractors	**2,254**
Demand Side Response Customer Survey	391
Project Management - ENWL	115
Remote Control Installation - Labour	844
Remote Control Installation at Customers' Premises	159
Contractors Travel & Publicity - Informing Affected Customers	42
Connections - Connections Design	303
Carbon Analysis	40
Data Analysis and Economic Modelling	185
Power System and Technical Modelling	175
IT	**740**
Data Capture and Cleanse	55
Database Licenses	100
Develop CRMS Reporting Capability	11
Develop CRMS/PowerOn (SOAP) Interface	87
Develop New Interface to PowerOn Fusion	87
Develop Real-time Data Update Functionality	55
Develop Visual Display Functionality for CRMS	73
Initial Data Load Functionality	55
System Integration & Testing	66
Testing and Development Workstation	10
Upload and Store Estimates (into historian)	85
Upload CRMS Diagram and Managed Loads	55
IPR Costs	**0**
Travel & Expenses	**0**
Payments to users	**300**
Demand Side Response	300
Contingency	**947**
Development and Preparation	44
Remote Control Installation	284
Publicity, Training and Dissemination	125
DSR and Interruptions	100
Project Management	28
Connections	102
Monitoring Equipment	77
Installation and configuration of IT and Implementation of PowerOn Fusion	109
Circuit selection and data upload	24
Analysis, Modelling and Development of Standards	41
System Integration & Testing	13
Decommissioning	
Other	**445**
Publicity and Dissemination	257
Accommodation	160
Unplanned interruptions during trial	27
Total	**10,275**

Source: Ofgem Schedule to Project Direction 19-12-11

APPENDIX B – RE-BASED PROJECT BUDGET (APPROVED 24 JANUARY 2013)

£'000s Excluding Partner Funding Ofgem Cost Category	Total Project Re-based Budget	Budget	Variance	Comments
Labour	**1,755**	**2,512**	**758**	
Monitoring Equipment Installation - Labour	22	22	0	
Business input into specs and testing & CIO System Design Approval	20	20	0	
Connections – Clerical	65	65	0	
Connections - Customer Relationship Management	241	241	0	
Dissemination - ENWL & Customer engagement via email & training	28	28	0	
Implementation of PowerOn Fusion	0	709	709	Moved to Contractor from Labour
Maintenance & Support for PowerOn Fusion	187	187	0	
Project Management - GE	0	351	351	Moved to Contractor from Labour
Project Management - ENWL	790	790	0	
Involvement in developing Future Network Planning/Operational Standard	15	15	0	
Circuit Selection	0	32	32	Contractors used instead of internal labour
Developing Future Network Planning/Operational Standard	0	53	53	Contractors used instead of internal labour
Connections - Connections Design	303	0	(303)	Internal labour to be used instead of contractors
Remote Control Installation	84	0	(84)	10% of Remote Control Installation by internal labour
Equipment	**3,078**	**3,078**	**0**	
Publicity Materials - Informational Pamphlets & postage & packaging	18	18	0	
Remote Control Installation - Plant	1,954	1,954	0	
Monitoring Equipment Installation - Plant	112	112	0	
Remote Control Installation - Materials	563	563	0	
Commissioning SCADA link to Remote Control Devices	31	31	0	
Delivery and configuration of GE IT hardware and software	399	399	0	
Contractors	**3,012**	**2,254**	**(758)**	
Demand Side Response Customer Survey	391	391	0	
Project Management - ENWL	115	115	0	
Remote Control Installation - Labour	760	844	84	10% of original budget moved to Labour
Remote Control Installation at Customers' Premises	159	159	0	
Contractors Travel & Publicity - Informing Affected Customers	42	42	0	
Connections - Connections Design	0	303	303	
Carbon Analysis	40	40	0	
Data Analysis and Economic Modelling	185	185	0	
Power System and Technical Modelling	175	175	0	
Project Management - GE	351	0	(351)	Moved to Contractor from Labour
Circuit Selection	32	0	(32)	Contractors used instead of internal labour
Developing Future Network Planning/Operational Standard	53	0	(53)	Contractors used instead of internal labour
Implementation of PowerOn Fusion	709	0	(709)	Moved to Contractor from Labour
IT	**740**	**740**	**0**	
Data Capture and Cleanse	55	55	0	
Database Licenses	100	100	0	
Develop CRMS Reporting Capability	11	11	0	
Develop CRMS/PowerOn (SOAP) Interface	87	87	0	
Develop New Interface to PowerOn Fusion	87	87	0	
Develop Real-time Data Update Functionality	55	55	0	
Develop Visual Display Functionality for CRMS	73	73	0	
Initial Data Load Functionality	55	55	0	
System Integration & Testing	66	66	0	
Testing and Development Workstation	10	10	0	
Upload and Store Estimates (into historian)	85	85	0	
Upload CRMS Diagram and Managed Loads	55	55	0	
IPR Costs	**0**	**0**	**0**	
Travel & Expenses	**0**	**0**	**0**	
Payments to users	**300**	**300**	**0**	
Demand Side Response	300	300	0	
Contingency	**947**	**947**	**0**	
Development and Preparation	44	44	0	
Remote Control Installation	284	284	0	
Publicity, Training and Dissemination	125	125	0	
DSR and Interruptions	100	100	0	
Project Management	28	28	0	
Connections	102	102	0	
Monitoring Equipment	77	77	0	
Installation and configuration of IT and Implementation of PowerOn Fusion	109	109	0	
Circuit selection and data upload	24	24	0	
Analysis, Modelling and Development of Standards	41	41	0	
System Integration & Testing	13	13	0	
Decommissioning	0	0	0	
Other	**445**	**445**	**0**	
Publicity and Dissemination	257	257	0	
Accommodation	160	160	0	
Unplanned interruptions during trial	27	27	0	
Total	**10,275**	**10,275**	**0**	

Source: Ofgem Schedule to Project Direction 19-12-11

APPENDIX C – DETAILED PROJECT EXPENDITURE

£'000s Excluding Partner Funding Ofgem Cost Category	Total Project Forecast	Re-based Budget	Variance	Comments
Labour	**1,499**	**1,755**	**256**	**Estimated at completion costs £256k favourable to plan (Connections efficiencies)**
Monitoring Equipment Installation - Labour	55	22	(34)	Higher than expected install unit rate. Manual collection of data & removal of equipment at end of Trial not budgeted.
Business input into specs and testing & CIO System Design Approval	27	20	(7)	Activity completed. Estimated at Completion cost £7k adverse to plan.
Connections – Clerical	61	65	5	
Connections - Customer Relationship Management	181	241	60	Lower than anticipated volumes leading to an extenstion to project during last reporting period. Estimated at completion cost £60k favourable to plan.
Dissemination - ENWL & Customer engagement via email & training	26	28	1	
Maintenance & Support for PowerOn Fusion	69	187	118	Anticipated efficiency. Estimated at completion £118k favourable to plan.
Project Management - ENWL (Labour)	717	790	74	Decrease in forecast due to change in headcount.
Involvement in developing Future Network Planning/Operational Standard	15	15	(1)	
Connections - Connections Design (Labour)	238	303	65	Lower than anticipated volumes leading to an extenstion to project during last reporting period. Estimated at completion cost £65k favourable to plan.
Remote Control Installation - ENWL Labour	110	84	(25)	Resolution of post go live bug fixes. Estimated at Completion £25k adverse to plan. Offset by outperformance of contractor costs.
Equipment	**2,625**	**3,078**	**452**	**Estimated at completion costs £452k favourable to plan (Remote control efficiencies)**
Publicity Materials - Informational Pamphlets & postage & packaging	17	18	1	
Remote Control Installation - Plant	1,812	1,954	142	Efficiency, estimated at completion £142k favourable to plan.
Monitoring Equipment Installation - Plant	179	112	(68)	Higher than expected equipment unit cost.
Remote Control Installation - Materials	218	563	345	Efficiency, estimated at completion £345 favourable to plan.
Commissioning SCADA link to Remote Control Devices	0	31	31	Efficiency, estimated at completion £31 favourable to plan.
Delivery and configuration of GE IT hardware and software	399	399	0	
Contractors	**2,888**	**3,012**	**124**	**Estimated at completion costs £124k favourable to plan (Remote control efficiencies)**
Demand Side Response Customer Survey	415	391	(24)	Additional costs for peer review of findings at project closedown
Project Management - ENWL (Contractors)	120	115	(5)	
Remote Control Installation - Labour	630	760	130	Efficiency. Estimated at completion £130k favourable to plan.
Remote Control Installation at Customers' Premises	95	159	64	Profile variance to plan, estimated at completion £64k favourable to plan.
Contractors Travel & Publicity - Informing Affected Customers	37	42	5	Estimated at completion £5k favourable to plan.
Carbon Analysis	42	40	(2)	
Data Analysis and Economic Modelling	201	185	(16)	PB Power support of co-ordination of universites during closedown
Power System and Technical Modelling	191	175	(17)	PB Power support of co-ordination of universites during closedown
Project Management - GE	351	351	0	
Circuit Selection	38	32	(7)	Activity complete. Actual spend £7k adverse to plan.
Developing Future Network Planning/Operational Standard (Contractors)	54	53	(0)	
Implementation of PowerOn Fusion	714	709	(5)	
IT	**610**	**740**	**129**	**Estimated at completion costs £129k favourable to plan (IT licences efficiencies)**
Data Capture and Cleanse	54	55	1	
Database Licenses	10	100	91	Efficiency, one licence required at £10k. Estimated at completion cost £91k favourable to plan.
Develop CRMS Reporting Capability	10	11	1	Activity completed. In line with plan.
Develop CRMS/PowerOn (SOAP) Interface	81	87	6	Activity completed. £6k favourable to plan.
Develop New Interface to PowerOn Fusion	92	87	(4)	Activity completed. £4k adverse to plan.
Develop Real-time Data Update Functionality	53	55	2	
Develop Visual Display Functionality for CRMS	78	73	(5)	Activity completed. £5k adverse to plan.
Initial Data Load Functionality	88	55	(33)	Activity completed. £33k adverse to plan.
System Integration & Testing	73	66	(7)	Activity completed. £7k adverse to plan.
Testing and Development Workstation	4	10	6	Activity completed. £6k adverse to plan.
Upload and Store Estimates (into historian)	45	85	40	Activity completed. £40k favourable to plan.
Upload CRMS Diagram and Managed Loads	24	55	31	Activity completed. £31k favourable to plan.
IPR Costs	**0**	**0**	**0**	
Travel & Expenses	**0**	**0**	**0**	
Payments to users	**245**	**300**	**55**	**Estimated at completion costs £55k favourable to plan**
Demand Side Response	245	300	55	Efficiency, estimated at completion £55 favourable to plan
Contingency	**439**	**947**	**508**	**Estimated at completion costs £508k favourable to plan (RC & connections efficiencies)**
Development and Preparation	14	44	29	Activity completed. £14k of contingency required.
Remote Control Installation	0	284	284	Activity completed. No contingency required.
Publicity, Training and Dissemination	118	125	7	Estimate full use of contingency required.
DSR and Interruptions	9	101	92	
Project Management	24	28	3	Estimate full use of contingency required.
Connections	11	102	91	Contingency utilised as a result of extenstion to project.
Monitoring Equipment	92	77	(15)	Higher than expected unit rates for labour and equipment.
Installation and configuration of IT and Implementation of PowerOn Fusion	109	109	0	
Circuit selection and data upload	1	24	23	Ongoing data upload and management, change to plan in last reporting period.
Analysis, Modelling and Development of Standards	42	41	(1)	
System Integration & Testing	16	13	(4)	Activity completed. £4k adverse to plan.
Decommissioning	0	0	0	
Other	**434**	**445**	**11**	**Estimated at completion costs £11k favourable to plan (Accommodation efficiencies)**
Publicity and Dissemination	291	257	(34)	Higher than expected unit costs of workshops/ seminars and trade articles
Accommodation	116	160	44	Estimated at completion £100k favourable to plan.
Unplanned interruptions during trial	27	27	0	
	8,740	**10,275**	**1,535**	

Source: Ofgem Schedule to Project Direct 19-12-11

APPENDIX D – PROJECT BANK ACCOUNT

The bank statement below details all transactions relevant to the Project during the last reporting period, from 01 June 2014 up to 30 November 2014.

Lloyds Bank
Statements and Balances

Yesterday's Statement **C082421**

[redacted]
ELECTRICITY NWL NO.11 LCNF (C2C) (GBP)

Date	Type	Narrative	Value Date	Payments	Receipts	Balance
30MAY14		Opening Ledger Balance				2,661,454.41 Cr
10JUN14	DR	ELECTRICITY NWL NO.4 PYMT TRANSFER 00648		83,772.52		2,577,681.89 Cr
19JUN14	INT	GROSS CREDIT INTEREST			3,469.17	2,581,151.06 Cr
27JUN14	CHGS	ACCOUNT CHARGE		1.02		2,581,150.04 Cr
25JUL14	DR	TO A/C TFR 02749020 300002		70,186.77		2,510,963.27 Cr
08AUG14	DR	TO A/C TFR 02749020 300002		104,497.97		2,406,465.30 Cr
11AUG14	CR	INTEREST (GROSS)			2,204.11	2,408,669.41 Cr
09SEP14	CR	INTEREST (GROSS)			956.09	2,409,625.50 Cr
09SEP14	DR	TO A/C TFR 02749020 300002		57,091.36		2,352,534.14 Cr
30SEP14	DR	SERVICE CHARGES REF : 154752518		1.11		2,352,533.03 Cr
09OCT14	CR	INTEREST (GROSS)			966.79	2,353,499.82 Cr
05NOV14	DR	TO A/C TFR 02749020 300002		80,507.97		2,272,991.85 Cr
10NOV14	CR	INTEREST (GROSS)			1,025.05	2,274,016.90 Cr
28NOV14		Value of Credits (5)			8,621.21	
28NOV14		Value of Debits (7)		396,058.72		
28NOV14		Closing Ledger Balance				2,274,016.90 Cr
28NOV14		Closing Cleared Balance				2,274,016.90 Cr

*** End of Report ***