Low Carbon Networks Fund
Full Submission Pro-forma

Section 1: Project Summary

1.1 Project title

Capacity to Customers (C_2C)

1.2 The Lead DNO

Electricity North West Limited (Electricity North West)

1.3 Project Summary

C_2C engages customers in an innovative form of demand/ generation side response that accommodates much higher demands on existing electricity networks without the need for reinforcement. Customers are at the heart of C_2C and it seeks to prove that the innovative application of existing technology together with new commercial offerings can be combined to meet customers' future low carbon needs at much lower cost. C_2C's technical elements leverage techniques developed for customer service improvements to offer significantly higher capacity to customers. C_2C will be piloted on HV networks supplying 12% of our customers allowing them secure access to the networks' previously unavailable latent capacity.

The C_2C Method is highly transferable across GB and the C_2C Project will deliver three key outputs: adaptive network automation to unlock significant capacity, new commercial contracts offering customers genuine choice, and a new design and operating standard to ensure security of supply in the low carbon future.

The C_2C Solution can deliver UK customer savings of at least £1Bn and avoid over 177 000 tCO_2e compared to traditional reinforcements with capacity being available on average four months quicker.

1.4 Funding

Second Tier Funding request (£k)	£9 109

DNO extra contribution (k)		**External Funding (£k)**	£488

1.5 List of Project Partners, External Funders and Project Supporters

IGE UK Ltd (GE)/ Parsons Brinckerhoff Ltd (PB) - technical support
Flexitricity/EnerNoc/npower - demand response
NGET - P2/6 development discussions
University of Strathclyde / University of Manchester - data capture/ analysis, modelling and dissemination
Tyndall Centre for Climate Change - carbon assessment
Association of Greater Manchester Authorities - Project Supporter

1.6 Timescale

Project Start Date	January 2012	**Project End Date**	December 2014

1.7 Project Manager contact details

Contact name & Job title

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Section 2: Project Description

"Our solution is timely, innovative, low risk, maximises utilisation of the installed network capacity and has the potential to deliver the requirements of the low carbon economy whilst limiting costs to customers"

Aims and objectives

The Problem which needs to be resolved in order to facilitate the low carbon future:

Insufficient network capacity to satisfy growing customer demand

As the UK fulfils its decarbonisation obligations under the Climate Change Act 2008, to cut greenhouse gas emissions by 80% by 2050, the demand on electricity networks will dramatically increase. Various reports forecast overall electricity demand to grow by 1.2% per annum to 600TWh/year by 2050, an approximate 100% increase from current levels (2050 Pathways Analysis Report, DECC). This increase in network demand will be driven primarily through the decarbonisation of heat, transportation and electricity production rather than by a growing population.

The Problem has two direct consequences which will need to be resolved in order to move the UK towards a decarbonised economy.

High costs to customers

Meeting growing demand requires additional network capacity and using traditional capital intensive reinforcement techniques would require significant investment. A 2009 Ofgem consultation document estimated that required investment in the GB transmission and distribution network could be as much as £53.4Bn between 2009 and 2025. Investment requirements are driven by the current planning and design standard, Engineering Recommendation P2/6 (ER P2/6), which requires that for every extra 10MW of capacity required, 20MW of infrastructure is needed. Such investment will have to be paid for by customers through higher connection and use of system charges.

Significant environmental & societal impacts

Addressing the provision of capacity using traditional reinforcement will also have a significant impact on carbon emissions and the wider society. Calculations endorsed by the Tyndall Centre for Climate Change Research have estimated that to release 32GW of capacity and assist in facilitating this demand would discharge 675 000 tCO_2e on a pure asset only basis, this is the equivalent to the average annual emissions of approximately 72 200 UK citizens.

The techniques that traditional reinforcement use are also very intrusive for local communities and can often involve extensive excavations and disruption. Average reinforcement timescales are in the region of 12-16 weeks for work involving cable upgrades or switchgear and much longer when involving new transformers or more complicated work.

The C_2C Method(s) being trialled to solve the Problem:

Current EHV and HV networks use redundancy to achieve security of supply standards, and often are interconnected by a normal open point (NOP) which is only utilised in the event of a network fault or planned outage. It is of note that nearly half of circuits do not suffer faults and one third experience faults lasting 1 - 2 hours every 5 years. Under such conditions, closing the NOP allows all customers affected by a fault outage to be re-supplied from the alternative circuit. This means EHV and HV circuits typically operate at only 50 - 60% of their rated capacity; it is this inherent capacity that the C_2C Method seeks to release for use by customers for the connection of new loads and generation.

Releasing this inherent capacity will be achieved by applying proven network techniques in conjunction with new customer commercial arrangements. Specifically the C_2C Method will redesign the network to allow the NOP to be run closed, allowing the whole capacity of the ring to be used by joining the two circuits

To ensure that security of customer supply is maintained and supplies can be restored during fault outages, the C_2C Method will develop and trial new post fault demand response contracts which will allow Electricity North West to reduce the consumption of contracted customers on the relevant circuits. When a new customer connects to the network they will be offered the option to sign up to a managed contract exchange for a reduced connection charge (equivalent to the saving of reinforcement costs). The contract will allow Electricity North West to manage their consumption at the time of a fault and enable Electricity North West

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to get all customers back online in as short a time as possible. It is envisaged that many future customers will opt for part of their demand to be managed in exchange for reduced connection charges. Figure 1 shows that following a fault the customer's demand will be managed allowing automatic restoration to the circuit within 3 minutes and then restored fully over a period of time, likely within an few hours as other resources are engaged.

The C_2C Trial being undertaken to test that the C_2C Method works

The Project seeks to test two different elements; 1. The technology used to enable the C_2C Method and 2. The customer engagement which facilitates the commercialisation of the Method.

Technology effectiveness

The effectiveness of the technology will be trialled by installing monitoring equipment on selected circuits and taking real time data from the network. This allows us to monitor the actual performance and conduct a series of network simulations and modelling exercises.

Customer engagement

Customer engagement will be trialled by testing the uptake of new commercial offerings. Customer engagement is at the heart of this trial. All Industrial and Commercial (I&C) customers on the selected circuits will be contacted directly. We will also publish a simple explanation of the C_2C Project to all domestic customers on these circuits. New contracts will be brought to market and tested for both new connection customers and for existing customers. These contracts will offer significant benefits for customers over traditional demand side response formats being both less intrusive and lower cost.

To ensure the trials deliver results and learning that is transferable to all UK DNOs, the C_2C Method will be tested on 180 HV closed rings (from the low to medium fault rate circuits) and 20 HV circuits (from the high fault rate circuits) and a smaller number of EHV circuits across the network. The target networks supply electricity to about 317 000 customers, close to 13% of Electricity North West's customer base and will deliver material and lasting benefits to both demand and generation customers in the trial area. The circuits chosen in the C_2C Project are highly reliable and have experienced low historic fault rates in previous years, these represent over 80% of Electricity North West's circuit population and allow the trial to be managed so as to minimise the effect of faults on customers. An additional 20 HV circuits (operated radially from the high fault rate group) have been added to the Trial to increase the number of fault experienced in the Trial and to test customers' acceptability for managed contracts across the range of circuit fault rates.

The C_2C Solution which will be enabled by solving the Problem:

By solving the Problem outlined above the C_2C Method allows for a significant increase in the amount of demand and generation on HV and EHV networks at much lower cost to customers. Project Partner, PB has undertaken a retrospective analysis of how the C_2C Method could have been applied to recent reinforcement projects. This case study analysis has shown that significant cost and time savings can be achieved through the use of the C_2C Method. Based on the analysis provided, on a £/MVA of additional capacity the C_2C Method will cost a customer £14 000 versus £91 000 for traditional reinforcement, a saving of £77 000/MVA. Compared to building a bigger network, using automation and managed contracts would release capacity with approximately 18 times less the carbon impact from the embodied carbon of assets and their installation. When applied to the North West network this would equate to £118M of savings out to 2035, and when applied to suitable GB networks this represents savings of at least £1Bn out to 2035. Table 2 summarises some of these projects and the key findings.

The figures in Table 2 only represent savings that could have been realised by the release of 25% of the available capacity ie loading the network up to 75% of its capability, for full details of the Case Studies see Appendix 7. From this work it is clear to see that the C_2C Method has huge potential to release existing capacity in a cost effective way.

Throughout the duration of the C_2C Project a number of outputs will be generated. The following are a summary of the key outputs from the trial:

1. *Adaptive network control functionality:* The trial will develop advanced network control functionality that will through productisation be available to all UK DNOs.

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2. *Demand response commercial templates:* The trial will produce a series of model commercial contracts that can be used by all DNOs to extend the C_2C Method and its benefits to all DNO customers.

3. *Customer segmentation template:* The trial will produce a customer segmentation template, describing how a DNO's customer base can be segmented and hence better approached for the introduction of demand response contracts.

4. *New connections process*: The trial will produce a new connections process detailing those technical and commercial steps required to extend the benefits to future C_2C customers.

5. *Overall customer feedback:* This includes feedback from customers participating in the C_2C Project including; comments on connections process, the form of response and feedback from customer engagement on planned interruptions and unplanned interruptions.

6. *Network data*: Detailed analysis of the benefits of the C_2C Method on network losses and power quality in the form of a full set of network performance data.

7. *Modelling/Simulation outcomes:* The simulations will provide a detailed technical and economic assessment of the benefits of the C_2C Solution..

8. *New design and planning standard*: The Method represents a fundamental change in the evolution of grids from passive to active operation and Electricity North West in conjunction with PB will produce proposals on new operating and design standards to inform the amendment or replacement of Engineering Recommendation P2/6.

Technical description of Project

The C_2C Project demonstrates technical innovation through the extended application of pre existing technology and network algorithms to move from passive to truly active network management for the benefit of customers.

Customer Engagement
The potential for the C_2C Method to utilise the capacity released to customers from existing infrastructure requires that new and/or existing customers are willing to adopt to new forms of commercial arrangements which allow the network operator to place a short duration restriction on their consumption and/ or generation as necessary in response to very infrequent fault outage events.

Traditional forms of Demand Side Response have primarily focussed on peak-lopping or load management or low load generation management. Although in its infancy there have been a number of industry players involved in the market, for example suppliers managing their portfolio and avoiding the triad period and network operators ensuring the network demand and/ or generation never exceeds the design capacity of circuits. The C_2C Method differs from these traditional Demand Side Response techniques in that it allows customers to choose a form of demand and/ or generation side response which is only called upon in the very rare event that the network experiences an fault outage. Historical analysis of the fault rates on the Electricity North West HV network has shown that the majority of HV circuits are extremely reliable and have had no faults within the last five years; only a very low number of circuits have had more than two faults over this same five year period. The application of C_2C Method to these highly reliable circuits means the frequency of call for this type of response will be very low and hence offer customers unrestricted access at other times.

It is known that a small number of circuits, known as rogue circuits, experience atypical fault rates, these are typically very long circuits and comprise significant amount of exposed overhead sections. The application of C_2C Method to these circuits is likely to result in an increase in the number of short duration interruptions, but conversely the duration of loss of supply will be shorter due to the introduction of the additional network automation points, necessitated by the C_2C Method. It is important to note that these rogue circuits tend to experience much less thermal congestion due to their remote location and in contrast it is the inherently reliable and densely populated urban centre networks, where the circuits are underground cables, which are expected to require expensive and time consuming reinforcement and which

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will therefore benefit hugely from use of the C_2C Method.

Demand and/ or generation side response can be provided by new customers at time of connection or from existing customers agreeing to new commercial arrangements. The customer proposition is very different by customer groupings. Electricity North West will identify those new customers seeking connection to a pre-selected closed HV ring in the trial area which requires associated reinforcement costs and propose an alternative C_2C connection arrangement. We will propose that there are no reinforcement costs in exchange for entering into new demand side response commercial arrangements. The Customer Survey results will inform the C_2C Project on the potential demand and/ generation side response capability from the existing customer base within the pre-selected HV closed rings and our Project Partners, EnerNOC, npower and Flexitricity will engage with I&C customers and seek to purchase Demand Side Response services to mitigate the need for reinforcement.

Technology Effectiveness

Automatic and active operation of closed HV rings

The C_2C Project will examine the benefits of the alternative operation of the existing HV network infrastructure which has been enhanced with modern network automation functionality. Specifically, the C_2C Method closes the normal open point (NOP) between two adjacent HV circuits to form a closed HV ring which will more effectively release the inherent capacity to customers. Existing infrastructure will be retrofitted with low cost proven remote control functionality at key locations on the ring in order to minimise the need to activate demand and/ or generation side response contracts and to minimise the need to activate contracts and to facilitate rapid re-supply to customers in the event of a fault outage.

Figure 2 illustrates the typical configuration of an HV network. ER P2/6 requires that in the event of a worst case fault, the network should be capable of restoring customers' supply within a defined timescale. This requirement for supply restoration results in the maximum available loading of the HV circuits to be constrained in the region of 50-60% of their maximum capacity.

In order to assist in the design of the C_2C Project PB has undertaken a review of design and operating practices amongst GB DNOs. This has shown that the configuration of electrical HV networks, as shown in figure 2, is used in the majority cases and therefore the C_2C Method is now known to be applicable throughout the majority of the GB network. Figure 3 shows the proposed alternative network of a closed HV ring.

From figure 3 it can be seen that the NOP between the two adjacent HV feeders has been closed and remote control equipment retro-fitted to the ring. The actual arrangement of automation in and around the closed ring is chosen based on an economic and performance assessment of the existing network in order to ensure that the overall network reliability and service to customers is not compromised.

The adoption of closed HV rings as illustrated in figure 3, if not mitigated, can potentially expose a greater number of customers to the risk of loss of supply in the event of a fault when compared to the arrangement shown in figure 2. This is because the size of the protected zone of network is increased when the NOP is closed. However, in order to mitigate against this the trials will test the inclusion of additional automation points on the ring which will ensure that overall network performance is not comprised by the adoption of the C_2C Method.

To illustrate this requirement, if we have two circuits, A & B, previously configured with the NOP open then a fault outage on A will interrupt electricity supplies to customers fed from circuit A. These can be restored from circuit B but only by manual switching at the associated substations. The customers supplied from circuit A will remain off supply for 1 -2 hours, whilst customers on circuit B experience no interruption. When the C_2C Method is applied to the circuits A & B, then in the same scenario the customers on both circuits now lose supply. However, the control system automatically segments the network so as to isolate the faulty section and restore all of the customers on circuit B and half the customers on circuit A, typically within a minute. The remaining customers on circuit A are still restored by manual switching. Whilst the number of customers affected by the fault increases, the time they are without supply is more than halved.

The traditional passive network asset based approach to the provision of additional demand or generation capacity is unable to facilitate the decarbonisation of energy and transport at low cost and will tend to act as a barrier to successfully achieving carbon reduction targets. The C_2C Method uses more active network management techniques, however these require improved understanding of real-time network loads.

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Adaptive network control functionality

In order to deliver the real-time functionality required for the C_2C Method it is necessary to integrate Electricity North West's control room management systems with operational applications provided by GE within their existing PowerOn Fusion™ product. The extent of the integration within the C_2C Project will be limited to minimise overall Project costs. GE is a Project Partner in the trial as their product is the dominant system used by UK DNOs and hence once the Method is proven transferability of the techniques is assured. Most HV networks do not have monitoring beyond the primary substation and little is known about the actual demand along individual HV circuits. The adaptive real time approach used in the C_2C Method will require an improved understanding of loading distribution within a network in order to optimise security of supply and minimise calls on demand and/ or generation side response. Existing distribution power flow algorithms within GE's PowerOn Fusion™ system will be used to estimate these loading at key network points based upon known customer data and measured analogue readings.

The GE PowerOn Fusion™ applications will be used to augment 's existing automation routines and control management systems allowing the combined systems to check as appropriate for potential violations before both automatic and manual network switching is undertaken. These calculations will run routinely in the background and the results will be made available within Electricity North West's automation systems for use in the event of a fault outage.

The adoption of the C_2C Method as a means of releasing capacity requires minor potential amendments to the existing automation algorithms and the development of linkages to the GE systems. These modifications and developments will supplement the automation software with the results of power flow analysis and ensure that the automatic restoration sequences are aware of the presence of relevant managed loads. The location, capacity and economic factors of all managed loads will be mastered within the GE systems.

A detailed description of the sequence of events that will occur in the event of a fault outage on any of the relevant network assets can be seen in appendix 13. It is important to note that the use of the demand and/ or generation side response within the context of C_2C is based upon the real-time requirements of the network at the time of the incident. This innovative approach will result in significantly less disruption to customers, with most affected customers only likely to experience a short duration interruption to allow for automatic sequence switching to be completed.

Power Quality and Losses Optimisation

The adoption of HV closed rings is expected to improve overall power quality and result in optimal power flows and thus improve overall like-for-like power efficiencies across the relevant networks. The improvement in power quality is a key factor in enabling future loads and generation types such as wind and PV to connect to the network as these loads tend to degrade overall power quality. The trial will test the extent to which the C_2C Method improves power quality via the installation of appropriate monitoring devices at key locations. This work will be carried out by Electricity North West with collaborative involvement of both the Universities of Manchester and Strathclyde.

Automation of interconnected EHV networks

Figure 5 shows an idealised representation of a typical interconnected EHV network used throughout the UK. The design of EHV networks is a holistic process which requires detailed engineering assessments of all loads connected to the relevant (ie. dependent) lower voltage networks. However, network operators in the UK are required to ensure that their EHV networks can readily accommodate credible outages without incurring loss of supply. Given these requirements, it is important that the managed demand utilising the release of capacity across the HV closed rings and the associated automation systems are activated as appropriate for given events on associated upstream EHV networks. The efficiency opportunities associated with dynamic load transfers between adjacent EHV demand groups are significant. However, this trial will limit the EHV functionality of the C_2C Method to the extent that managed demands will be disconnected when appropriate in the event of a fault outage on the relevant EHV network. The use of the techniques underpinning the C_2C Method is an important first step toward the ultimate goal of self healing electricity networks.

Description of design of trials

Scope of C_2C Project

In order to ensure that the C_2C Project trial is representative of the whole network it will incorporate the closure of NOP on 360 HV circuits in turn creating 180 HV closed rings, this will address a statistically

2: Project Description cont.

significant 12% of the Electricity North West network. Through the closure of these NOPs the Trial will be making available ≈3MVA of additional capacity on each of the closed HV rings. The Trial will look at both existing I&C customers, of which there are about 1 270 on the selected rings, as well as new connections customers which will appear during the project life.

The circuit selection methodology has been developed in conjunction with PB and ensures the trial will represent the various configurations, types and voltages of circuits used by all DNOs. The circuits selected will also adequately represent the range of network constraints that would typically require the reinforcement of distribution networks using a traditional approach. The details of the methodology can be seen in Appendix 10. The initial results of applying the circuit selection methodology to HV circuits has been undertaken and can be seen in on the network map within Appendix 1 - screening has reduced the circuits from 3 000 to about 400. In addition, we have engaged PPS Group to contact local planning authorities across the region to identify those areas designated for development, thereby enhancing the opportunities for new connections and maximising the number of customers who will have the opportunity to be involved in the trial. The PPS report can be seen in Appendix 8 and we will utilise this research in the final selection of circuits to be completed in phase 1 of the delivery plan for the C_2C Project.

Based upon internal empirical evidence it is estimated there will be approximately 24 & 20 faults outages pa across the 180 HV rings and the 20 HV circuits which translates to about 50 & 35 faults across the period of the Project. The evidence also indicates that there will be in the region of 42 new I&C load connections and 10 new renewable generation connections on these circuits over the period of the C_2C Project.

Hypotheses

The C_2C Project will examine 7 hypotheses via a combination of real time data analysis, network simulation and customer engagement trials. The hypotheses are:

1. The C_2C Method will release significant capacity to customers (in the range of 75% to 100% of available capacity/ circuit rating) from existing infrastructure.
2. The C_2C Method will enable improved utilisation of network assets through greater diversity of customers on the network ring.
3. The C_2C Method will reduce like-for-like power losses initially but this benefit will gradually erode as newly released capacity is utilised
4. The C_2C Method will improve power quality resulting from stronger electrical networks
5. The C_2C Method will facilitate lower reinforcement costs for customers for the connection of new loads and generation
6. The C_2C Method will effectively engage customers in a new form of demand and/ or generation side response thereby stimulating the market and promoting the future use of commercial solutions to address the Problem.
7. The C_2C Method will facilitate a reduction in the carbon costs of network reinforcement.

Trials

To test the hypotheses outlined above we will use a number of different tests and measurement techniques. Table 1 shows the variables that will be investigated and how they will be trialled.

Technology Effectiveness

Hypothesis 1 and 2 will be explored through the field Trial and network simulation. For real time analysis live network data will be collated to ensure that the correct sequence of events takes place at the time of a fault outage and that customers receive a suitable service. Network simulations will examine scenarios that will not be replicated in the field Trial phase of the Project, but will enhance our understanding of the Method by being able to more fully explore states that may not be experienced in the future and/or in other scenarios that may not be experienced in the field during this Project. The simulations will involve analyses of steady states and of transition states where the network topology and/or loading are changing due to reconfiguration and/or generation/load management activities.

2: Project Description cont.

It is proposed to install power quality measurement devices on 36 out of the 180 HV rings and 20 HV circuits to test hypotheses 3 and 4. These rings will be specifically chosen as representative of the total. This equipment will record voltage, current and harmonics at specified locations on the HV ring as advised by our University Partners. It will be necessary to install four separate devices along the ring; two of these will be at the source end of the ring within the primary substation and two will be on the network at or close to the associated normal open-point. No planned supply interruptions are required to install this equipment. The University Partners will carry out an analysis of all of the data being produced from the monitoring systems and together with network simulations this will be used to develop a general view on the capacity that is not being utilised.

System studies will be performed to establish the performance of the network under both present and future scenarios. The future scenarios will be agreed with Project Partners and should be chosen to represent situations where load and distributed generation (DG) growth is such that the “limits” of the C_2C Project may be identified. These limits may be with respect to security of supply and relevant power quality standards.

These simulation exercises will further test hypotheses 3 and 4. Real and reactive power flows, fault levels, losses and voltage profiles can be computed for all network states. This information can then be used to assess the power quality and utilisation as well as risks and benefits associated with the implementation of the C_2C Method. All losses information will be fed into the assessment of carbon benefits of the C_2C Project, in addition the simulations will allow assessment of the carbon costs associated with network capacity needed to support low carbon demand growth or low carbon generation, informing hypothesis 7. The modelling work will also inform other work examining the economics of the C_2C Method in comparison to alternative strategies such as reinforcement and how customers should be charged for connections and rewarded for demand side response in the future.

Customer Engagement

The technology used to enable the C_2C Method releases the available capacity whilst the customers, via demand and/ or generation side response contractual arrangements, realise its utilisation. By offering both new and existing customers up to post-fault demand and/ or generation side response contracts the C_2C Project seeks to prove that the Method can be implemented in a manner acceptable to customers. The C_2C Method offers customers a genuine choice of service and price options and thereby seeks to positively engage customers in helping to resolve the Problem.

To test hypothesis 6 the trial will develop a segmented view of the 1 270 I&C customers to assist in formulating, framing and targeting new commercial offerings. This will involve the gathering and collating of customer-related data from Electricity North West systems, minor data integration, and if needed enrichment in order to build a customer database which provides meaningful and usable customer information. The data will be cleansed and enriched using standard industrial classification codes and/or other publicly available demographics data. This will provide Electricity North West with a holistic view of customers within the Trial area and the methodology developed will be made available to the UK DNOs. Customer data will be improved with attitudinal and behavioural information in order to obtain a deeper knowledge of the customer. This will be achieved through qualitative research; customer interviews and surveys and will result in a clear and defined list of customer segments which will be used to develop a market size, tailored commercial arrangements and campaign development.

Next the C_2C Project will conduct wide desktop and qualitative research to understand typical demand and/ or generation response arrangements in key markets. This will allow Electricity North West to generate new commercial templates for 1) demand side response; 2) generation side response; and 3) combined site response for new and existing customers.

To test hypothesis 5 customer engagement will be measured and tested through the uptake of the new contracts for existing customers and for new connections customers. Customers are generally not familiar with demand side response and those that are, are generally aware of the standard forms of demand side response which have been previously discussed. In our previous customer engagement[1] for demand side response services we have learnt that we need to engage early with customers, provide clear and concise briefing materials and be there to support and answer questions as customers start to understand the implications for their business operations from the provision of demand side response services; this learning has been built into our Trial.

[1] Electricity North West has contracted with a load customer for reduce demand at peak times in winter period and with a load customer with significant generation capability to reduce demand by increasing generation at summer peak period.

2: Project Description cont.

The C_2C Project will investigate different communication channels to the end customer. Electricity North West will manage the relationship with a new customer for connection to the distribution network. Whilst the ProjectPartners, EnerNOC and Flexitricity in partnership with npower, will test the difference between direct customer contact and contact via a supplier relationship.

Existing Customers: The trials will affect 13% of Electricity North West's customers and potentially involve 1 270 I&C customers. During the C_2C Project we will proactively communicate with all I&C customers in the Trial areas. These customers will receive the opportunity to opt into a Demand Side Response contract in return for payments from Electricity North West. It will be the role of the aggregation partners to seek opportunities in this area.

New Connections Customers: A dedicated C_2C connections team will be embedded within Electricity North West's connections business to manage the marketing, customer engagement and customer relations with new I&C customers and developers seeking connection to one of the pre-selected closed HV rings. The following steps detail how we will provide information to a customer which allows him/her to make an informed decision whether to opt in to the C_2C Project.

Step 1: It is proposed that an I&C customer seeking a new connection of 100 kVA or above which requires reinforcement will receive a standard connection offer, in compliance with the Electricity Act, distribution licence and within Electricity (Standards of Performance) Regulations timescales. This connection offer will follow the standard design process and in addition briefing information on the C_2C Project will be included in the standard connection offer.

Step 2: Once this obligation has been fulfilled the C_2C Project team will contact the customer and provide a C_2C connection offer to the customer along with information on the performance statistics of the HV closed ring and new commercial arrangements. The provision of the C_2C connection offer allows the customer to compare and contrast the offers. The C_2C connection offer will be provided as timely as possible, but is not subject to Electricity (Standards of Performance) Regulations timescales.

Step 3: If the customer chooses C_2C, the connections team will meet the customer to discuss the offers.

Appendix 6, the Customer Engagement Plan shows the connection process map detailing the above steps and this information. At all times the customers have the choice to opt in or opt out of the C_2C Project. Electricity North West will record the time to deliver the C_2C connection offer and the length of time to discuss until a conclusion is reached by the customer. This information could be useful to Ofgem for the design of future potential performance standards applicable to connections offer with a C_2C type arrangement.

Changes since Initial Screening Process

In the ISP we mentioned that we would be involving a number of academic institutions in the Project, we can now confirm that both the University of Manchester and the University of Strathclyde are Project Partners. In addition, we have added National Grid Electricity Transmission (NGET) to the list of Project Partners. It was also noted in the ISP that the Project was scheduled to run for 2.5 years, from Jan 2012 to Jun 2014. However, this has been extended by 6 months and the Project will run until Dec 2014.

2: Project Description Images, Charts and tables.

Figure 1: Post Fault Capacity Restoration Profile

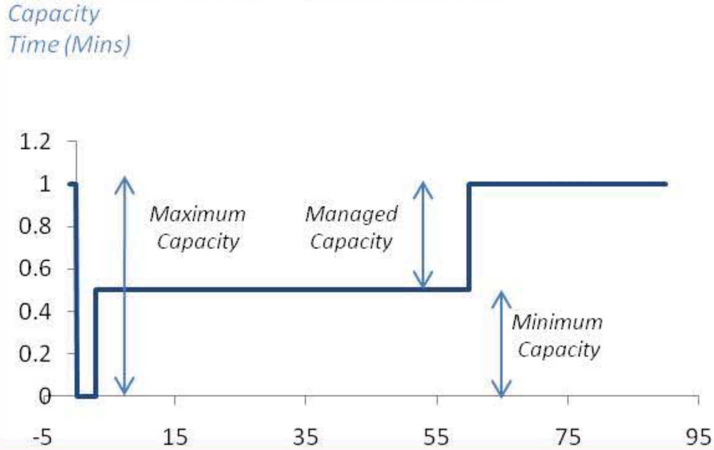


Figure 2: Typical HV Network Configuration

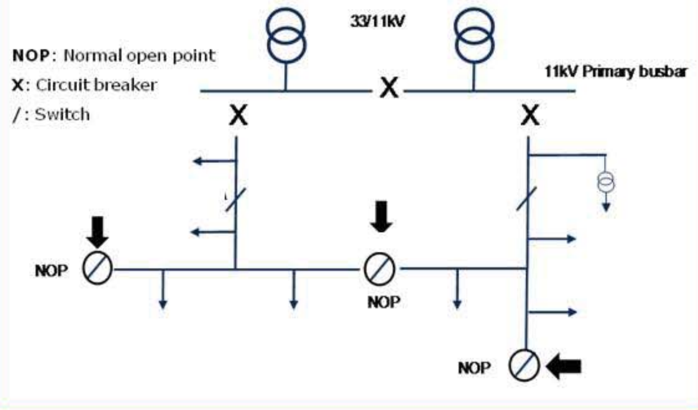


Figure 3: Innovative configuration of closed HV ring

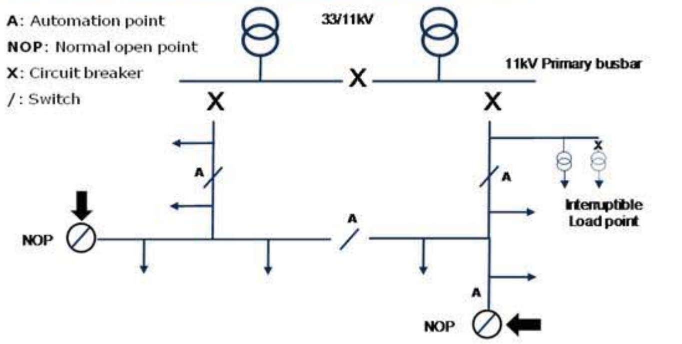


Figure 4: Typical EHV network arrangement

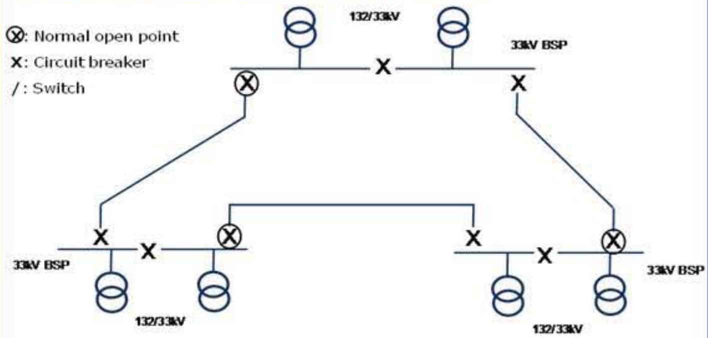


Table 1: Variable to be Tested

Trial Techniques	DSR/GSR appetite	Capacity Release	Connection Costs	Carbon Emissions	Reliability (IIS)	Power Quality	Losses
	Variables to trial						
Customer engagement	✔		✔				
Real time analysis		✔	✔	✔	✔	✔	✔
Modelling		✔	✔	✔	✔	✔	✔
Simulation		✔		✔	✔	✔	✔

Table 2: Traditional Reinforcement vs. C_2C

Scheme	Additional Capacity Created (MVA)		Direct Cost of Capacity Created		Savings
	Trad. Reinforcement	C_2C*	Trad. Reinforcement	C_2C	
Macclesfield	2.86	4.38	£235,849	£15,000	£220,849
Salford	3.50	2.09	£36,201	£75,000	-£38,799
Irlam Primary	5.85	8.58	£3,243,435	£15,000	£3,228,435
Cheetham Hill Primary	5.50	8.75	£1,457,852	£15,000	£1,442,852
Atherton Town	13.34	2.86	£461,681	£15,000	£446,681
Cog Lane	4.17	2.09	£393,450	£15,000	£378,450
Ormskirk	6.95	3.81	£152,120	£15,000	£137,120
Copse Road	1.09	2.29	£87,000	£15,000	£72,000
Woodfield Road	7.62	4.57	£194,000	£55,000	£139,000

*based on release of 50% capacity *Total Saving:* ***£6,026,588***

Section 3: Project Business Case

"As the UK moves towards a low carbon economy our Solution allows cheaper and quicker customer connections offering significant financial savings to customers over the coming years"

We believe that the C_2C Project will be instrumental in enabling the transition to the low carbon future delivering GB-wide benefits for all energy customers, both in terms of costs savings and carbon reduction. Our business case is based upon the principle of deploying the C_2C Solution across our own network within the North West and in a manner that enables expanding to all relevant networks within GB.

The majority of these benefits can be quantified and where appropriate the business case has sought to do this. However, there are other benefits that although cannot be directly quantified have been explored and described in the sections below.

The business case includes an investigation into the costs associated with the Project and these have been developed in collaboration with our Project Partners throughout the bid preparation phase.

Should the trial be undertaken without the support of the LCN Fund the project would deliver a negative NPV for Electricity North West as the benefits are realised wholly by our customers. The knowledge gained in undertaking the C_2C Project will allow Electricity North West to build on its previous Demand Side Response work and better understand how customers will play an integral part in the running of the network in the future allowing learning to feed into RIIO-ED1.

Assuming positive customer engagement, the Project does demonstrate significant customer benefits. Once all infrastructure and losses costs have been taken into account the Trial alone will deliver £11.4M of net benefit to customers through reduced reinforcement costs and Demand Side Response payments. This is calculated based on an extrapolation to 2035, which is a conservative estimate of the period of deferred reinforcement. When the Trial is scaled up to the Electricity North West network, the customer benefit is estimated at £118M, and across the suitable parts of the GB network, customer benefits exceed £1Bn. Full details can be seen in Section 4b and the business case workbook in Appendix 2.

Customer Benefits

Electricity North West has undertaken initial modelling work on the potential benefits of its C_2C Project. This modelling has been based on assessing a sample of real customer connection applications and general reinforcement projects, and the associated network reinforcement expenditure. Electricity North West and PB have examined these case studies to determine both the viability of the proposed C_2C Solution and to assess their value to customers. Under the C_2C Project Electricity North West will more accurately quantify the benefits arising from the Method, enabling Ofgem and network operators to examine future incentive arrangements and allowance mechanisms within the new RIIO (Revenue, Incentive, Innovation, Output) price control.

Financial Benefits

The principal benefit to customers of the C_2C Solution is that it enables significant additional network load and generation to be connected, without incurring the high levels of expenditure associated with traditional HV and EHV network reinforcement. Electricity North West's analysis shows that if the technical and commercial elements of the C_2C Solution were adopted across the Electricity North West network, then it would release 2.4 GW of existing capacity on the HV networks, without reinforcement. This is around 35% of the existing firm HV network capacity or around 50% of simultaneous HV demand. Analysis of electrical energy scenarios to 2050 suggests the C_2C Method could thus replace much of the traditional HV reinforcement activity in the period to 2035; however this is viewed as a conservative estimate and could indeed defer reinforcement in certain networks to 2050.

Delivering 2.4 GW across the North West through the C_2C Solution would cost in the region of £155M, inclusive of the cost of increased losses and automation equipment; delivering the same capacity through traditional reinforcement techniques would be expected to cost approximately £273M. It's clear to see the C_2C Solution has the potential to reduce total future HV network reinforcement costs (ie both customer and DNO funded) by approximately £118M over the period 2015 - 2035, avoiding future expenditure requirements associated with increasing network capacity for a low-carbon future. Should the C_2C Solution be scaled up and rolled out across suitable GB networks, the customer savings are even more significant. Combining analysis by PB (Appendix 10) with the length of each DNOs network indicates that the C_2C Method could be applied to 90% of the total GB network. Taking into consideration the cost of network losses and automation equipment installation the total customer saving would be approximately £1.06Bn

3: Project Business Case contd.

to 2035.

Importantly this saving would not require customers to moderate their load or generation usage in terms of time or level of use, other than under rare fault conditions. This limited restriction to customer usage of networks coupled with the significant financial savings on reinforcement costs are the principal customer benefits of the C_2C Project.

Carbon Benefits

The C_2C Solution negates the need for much of the engineering works associated with reinforcement, by better using the installed network capacity. This has two significant spin off benefits.

Firstly it enables much more rapid connection of load and generation, as little or no engineering works are required. This will enable customers to move to low carbon heat and motive technologies and adopt distributed generation technologies without waiting for works to be completed (on the higher voltage networks). Based on advancing connections by around 4 months, the C_2C Method could directly claim to facilitate 200-500 thousand tCO_2e of emissions reductions in our network area (depending on how the capacity is used). On the scale of Great Britain, this carbon saving would be of the order of 4.8 million tCO_2e to 2035. This will become an increasing important factor as the growth in connection of new loads and generation accelerates. Without such techniques network operators may not be able to construct sufficient capacity quickly enough to meet customer needs.

Although enabling release of capacity is the primary benefit, the second benefit is that the technique significantly reduces the carbon associated with asset installation and construction, and it reduces disruption and pollution to customers arising from constructing these new assets. It also negates the potential incidental environmental impacts of engineering works on tree roots and water courses. Section 4a and Appendix 11 describe the basis of these quantitative estimates.

Electricity North West's analysis, verified by the Tyndall Centre (for Climate Change Research), indicates that C_2C Solution deployment on Electricity North West's HV network in the period 2015 - 2035 would give a net network wide reduction of 14 500 tCO_2e, based on saving some 46 300 tCO_2e network wide from reduced deployment of assets, but increasing carbon associated with losses by 31 800 tCO_2e relative to traditional reinforcement techniques.

On many HV circuits, analysis shows that deployment of the C_2C Solution reduces network electrical losses. For example if C_2C were deployed across the Electricity North West HV network in 2015, then the reduction in electrical losses in 2016 would be equivalent in that year to nearly 8 000 MWh or more than 3 000 tCO_2e. However as load increases over time, losses will increase for both the C_2C Method and traditional approaches. Using the case studies analysed by PB, we estimated at future loading that 32% of HV circuits have lower losses using the C_2C Method compared to the traditional approach, 65% marginally higher losses and 3% neutral.

Non quantified Benefits

Whilst the C_2C Method demonstrates significant financial and carbon saving benefits there are also a number of non quantifiable benefits that should be noted. The first of these is how the Solution will inform discussions on RIIO-ED1.

One of the key aspects of RIIO-ED1 is innovation and effective planning, and companies will benefit from demonstrating this. The C_2C Project demonstrates innovation through pioneering use of Quality of Supply driven advancements, the development of new demand and/ or generation side response products and effective customer segmentation. Another key consideration of RIIO-ED1 is the delivery of network services with long-term value for money for existing and future consumers. Learning from C_2C the Project will inform whether the innovative use of automation and demand and/ or generation side response can offset network reinforcement and pave the way for better value for money delivery of network services.

This will also inform if the Solution can play a role in the delivery of a sustainable energy sector, reducing the carbon intensity of current network operations. Further inputs will be generated for discussion in amending the Distribution Connection and Use of System Agreement in the areas of National Terms of Connection and charging methodologies: Common Distribution Charging Methodology, EHV Distribution Charging Methodology and Common Connection Charging Methodology.

3: Project Business Case contd.

In addition to alignment to the objectives of RIIO-ED1 the Method also supports the evolution of new forms of demand side contracts and hence promotes competition in the Demand Side Response market. Traditional Demand Side Response forms have not yet proven to be acceptable to customers without strong financial incentivisation. The introduction of new forms of low intrusion Demand Side Response will engage customers in the new Demand Side Response markets via connection benefits and thereby promote further follow on Demand Side Response engagement. Network companies can be expected to support growth in the demand side and its integration into market and balancing activities. This will help ensure that benefits are passed through to the customer.

DNOs are financially exposed to changes in losses through the regulatory losses incentive, but DNOs currently have no regulatory incentive to benefit from reducing asset-related carbon emissions. Results from the C_2C Project will help quantify the relative changes in capital investment efficiencies versus losses, how that would affect the choice of circuits to which the C_2C Solution might be applied, enabling an informed debate on the setting of relative incentive rates and regulatory frameworks for carbon and losses reduction.

The C_2C Solution also has the potential for network operators to divert capital expenditure from their HV networks to their LV networks; which are likely to require additional expenditure in future years. Although this has not be quantified at this stage, reduction in HV expenditure levels could assist in offsetting significant investment in the LV networks could help and hence provide tariff stability and protect customers through the provision of price stability in distribution tariffs.

Costs and Assumptions
By working with a variety of companies including Accenture, GE, PB and Flexitricity we have been able to develop a robust set of cost data for the equipment required and man power required to deliver the C_2C Project across our region. The total cost of the project is estimated to be £10.76M. Funding for the total cost will come from the following four areas:

1. LCNF: £9.109M
2. Electricity North West Contribution: £1.028M
3. Project Partners: £0.489M

This Partner funding has come from GE who are providing certain elements of hardware and software and some ongoing maintenance and support. NGET are also supporting the project through the provision of experienced support as the project investigates the development of the design and planning standards.

The total has been broken down into the following main cost segments:

- Project Management = £1.04M
- Control systems technology = £2.9M
- Automation, monitoring and communications infrastructure = £3.68M
- Commercial = £1.46M
- Learning and dissemination = £0.7M
- Contingency = £0.98M

The primary cost category is the control systems technology and field automation and monitoring infrastructure, this includes the hardware and software elements of the Project as well as the integration between the GE applications and the Electricity North West network management system. A detailed breakdown of the cost components can be seen in the table on page 17 and also within the project business case in Appendix 4.

3: Project Business Case contd.

In developing the project costs the following key assumptions have been made:

- All costs include RPI
- RPI rates are those issued by Ofgem
- Project funded costs include 10% contingency.

Electricity North West Direct Benefits and Contribution

Through the period of the trial Electricity North West hopes to attract a number of new connections customer to connect using the C_2C Method. By signing up customers in this way Electricity North West will see a small direct benefit to its connections allowance. Although minimal, this will form a portion of Electricity North West's DNO Contribution and has been documented.

When comparing the cost to customers of connection through the C_2C Method versus traditional reinforcement the cost saving is in the region of £46 000. Taking 62% of this as the Electricity North West contribution brings the number to £28 600. Of the £28 600, 60% is attributable to direct benefits rather than indirect benefits which brings the total down to £17 300. It is estimated over the course of the Project that 30 projects will be completed, making the total direct benefit, in allowance payments, to Electricity North West of £0.52M.

As part of the LCNF mechanism Electricity North West are responsible for contributing 10% of the total project cost, this currently represents a contribution of £1.02M. Given the above commentary £0.52M of this would be funded through direct benefits and £0.50M straight from Electricity North West.

The C_2C Project has been through the Electricity North West internal approval process and has been signed off by the Board.

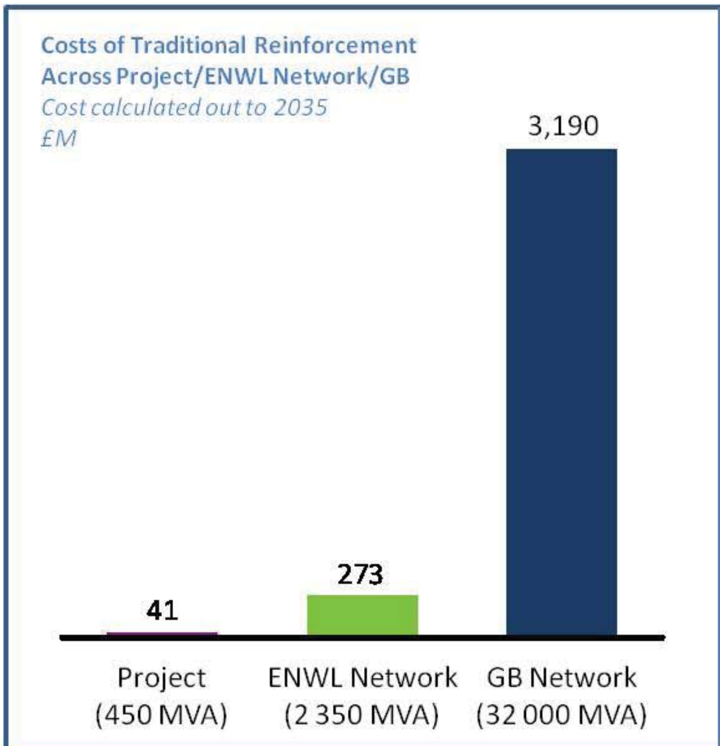
Sensitivities

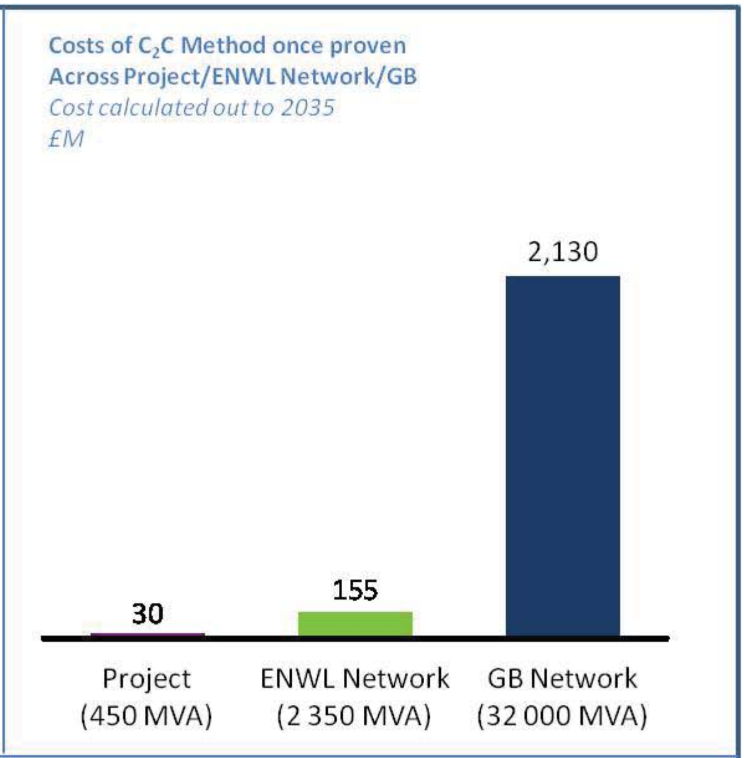
Regional and GB benefits are sensitive to the willingness of customers to enter into commercial arrangements that can deliver reinforcement savings whilst maintaining expected security of supply standards. If network redundancy is reduced then network operators require a very high degree of confidence that demand response load will be available when it is needed, highlighting the importance of customer engagement and compelling customer propositions.

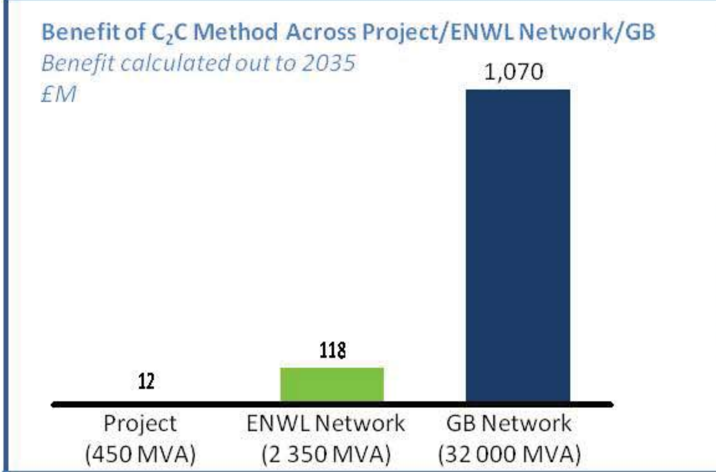
3: Project Business Case contd.

3: Project Business Case contd.

3: Project Business Case images, charts and tables.

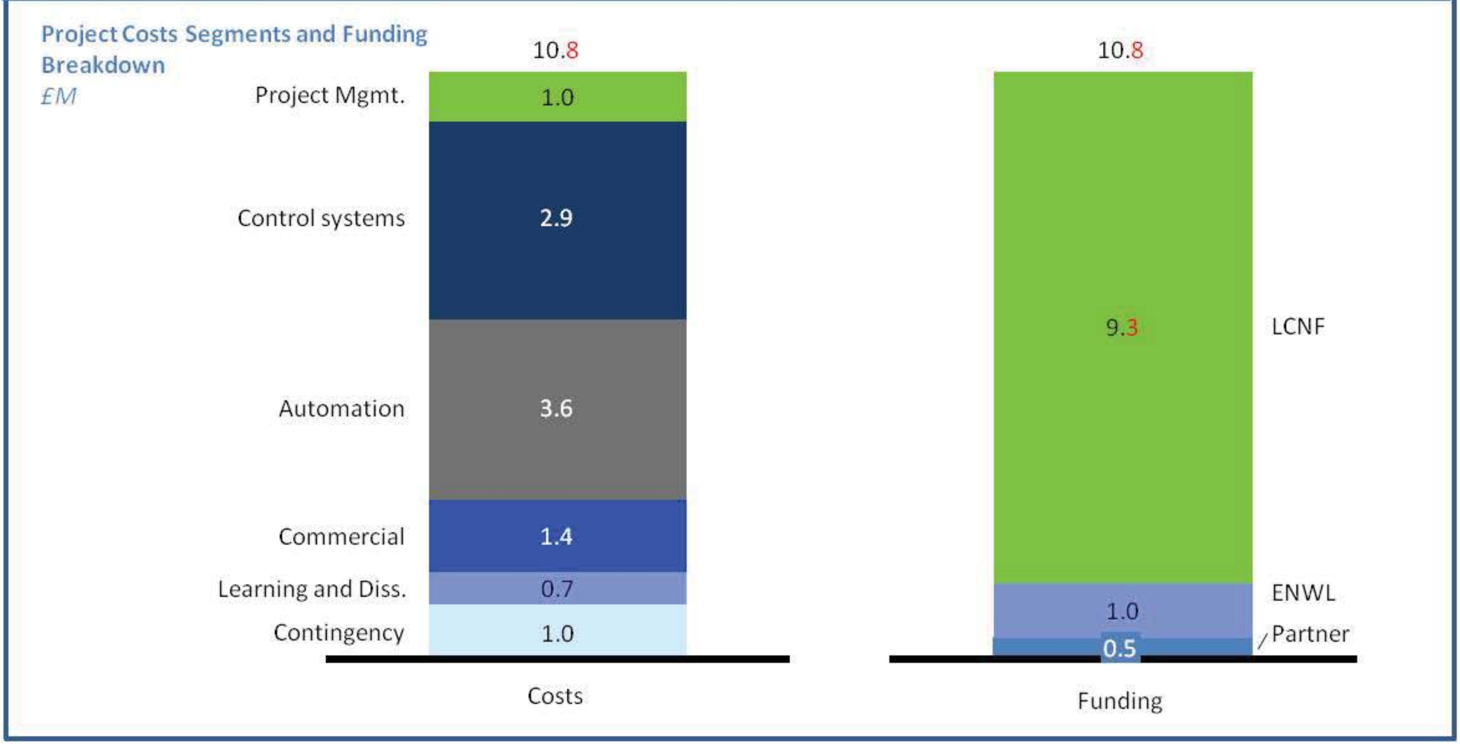






Cost breakdown *£M per year*

Cost Category	2011/12	2012/13	2013/14	2014/15	Total
Project Management	£80,628	£326,847	£351,455	£280,746	£1,039,676
Technology - CST	£937,966	£1,612,484	£231,440	£119,238	£2,901,128
Technology - AMCI	£432,651	£3,121,104	£86,376	£44,548	£3,684,679
Commercial	£0	£610,461	£550,653	£300,225	£1,461,339
Learning and Dissemination	£61,500	£317,001	£279,062	£41,318	£698,882
Contingency	£122,750	£497,329	£227,623	£130,868	£978,570
TOTAL	**£1,635,495**	**£6,485,225**	**£1,726,609**	**£916,944**	**£10,764,273**



Project Business Case images

Section 4: Evaluation Criteria

"Through cheaper connection charges and innovative distributed energy management arrangements C_2C will enable customers to switch to lower carbon technologies, reducing their carbon footprint"

Accelerates the development of a low carbon energy sector

The C_2C Method will accelerate a low-carbon future by releasing a significant amount of the distribution network pre-existing capacity that will be used to meet the UK's objectives to use renewables and reduce carbon emissions. Crucially the C_2C Solution will release this capacity more cost-effectively, much more quickly and with lower disruption and carbon impact than current reinforcement methods.

In all plausible decarbonisation scenarios to 2050, there is a considerable increase in electricity demand and HV network capacity requirements. However there remains considerable uncertainty as to the precise scale of increase, depending on the mix of technologies and behaviours in the decarbonisation pathway. Our analysis of published scenarios suggests electricity demand and HV network capacity requirements could plausibly rise by 50-100% by 2050.

In this section and supported by Appendix 11 we set out how we have quantified the impacts of the C_2C Solution on accelerating release of capacity, but some headlines are given here.

C_2C Project: The circuit selection methodology (described in Appendix 10) identified that 180 rings would be used in the Trial. This suggests potential for 450 MVA of capacity to be released earlier and at significantly lower cost than with current approaches. The C_2C Project will demonstrate the concept, with the full scale of the 450 MVA utilised in the longer term.

Electricity North West: Rollout across the Electricity North West network could deliver 2.4 GVA over 1 000 HV rings. Adding 35% to the existing firm HV network capacity or around 50% to simultaneous HV demand. Compared to the 50-100% expected increase in requirements by 2050, this suggests a timescale to 2035 as a reasonable conservative working assumption for the approximate period over which C_2C could replace traditional HV reinforcement on a significant proportion of our network. C_2C could release enough HV network capacity for 1.3M electric vehicles, plus 1.8M domestic heat pumps and 470 wind turbines.

Great Britain*:* A rollout of the Solution across GB could release 32 GVA of capacity across 13 700 HV rings. That would be equivalent to getting capacity early for 18M electric vehicles, plus 25M domestic heat pumps, plus 6 500 wind turbines over the period to 2035.

In addition to accelerating the low-carbon energy sector via faster and cheaper capacity release, the Solution will also accelerate its development by stimulating the demand-side response market. By positive engagement with network users, it will stimulate new entrants to the wider market for demand and/ or generation side response beyond C_2C, increasing potential carbon savings and providing new options for system balancing. If facilitated demand response is able to contribute to national system margin, this may have a benefit of 300 - 750 tCO_2e /MW/yr.

A roll-out of C_2C across GB - contribution to aspects of the Low Carbon Transition Plan (LCTP)

To meet the LCTP more low carbon electricity generation will need to connect to the UK electricity system to facilitate increased demand. These changes in generation and demand will significantly increase customers' requirements for HV network capacity; the C_2C Solution will address this cost-effectively, quickly, with less disruption and with lower carbon impact than current reinforcement methods.

In the high-level five-point plan in the LCTP, the C_2C Solution contributes to `Building a low carbon UK' and `Supporting individuals, communities and businesses to play their part', and relates to the aspects detailed below from Chapters 3-7 of the Plan:

- The C_2C Solution would help decarbonise the heat and transport sectors by helping to provide the high helping to provide the HV element of network capacity to accommodate increased electricity demand from heat pumps and electric vehicles and rail electrification.
- A significant proportion of the new low carbon generation, including many wind farms, biomass, hydro and CHP projects, will be connecting to HV distribution networks. The LCTP considers these distribution level aspects are important for overall decarbonisation of the power sector, in combination with low

4: Evaluation Criteria contd.

carbon generation on the transmission network. The C_2C Method would help by reducing connection costs for connecting renewables and CHP to the HV distribution networks, and enabling connections to proceed more quickly.

The LCTP also sees an important role for businesses to reduce their own emissions; the electricity network industry is part of this. The C_2C Method would deliver reductions in network asset emissions. As mentioned above, the impact of C_2C on carbon emissions from losses is generally beneficial particularly during the next 10 years when generation remains largely carbon based. The longer term balance is complex and will be explored further in the project.

Specifically considering the `smart grid' portion of the LCTP, the $C_2C$ Project reflects aspects such as `more optimal usage of the whole network in meeting demand', `demand side management' , `decisions ... on a real time basis', but brings technology and customers together in a tangible example of this. The LCTP announced government's call for evidence on how to exploit greater demand side involvement. The C_2C Solution is a way to deliver this, but extends also to generation customers, and by encouraging new forms of demand side response contracts, it helps to stimulate and mature the overall demand side response market.

How a roll out of the Method across GB will deliver carbon benefits more quickly
Traditional reinforcement can involve disruptive construction activities and carbon intensive assets eg when new cables and transformers are installed. Time is involved in the scoping, design, approval, construction and commissioning of new assets on the HV and EHV networks. This type of practical problem is increasingly likely, as electricity demand and generation can be expected to increase in existing urban areas, rather than simply extension to new rural areas.

In contrast, with the C_2C Method, once the network management system and customer processes have been implemented, capacity can be released for use simply by installation of automation on the appropriate circuits. This capacity can be fully utilised as soon as customers enter managed contracts. Note, the C_2C Method releases capacity across the entire ring, whereas traditional reinforcement only releases capacity at the new connection. Thus the C_2C Method provides a more flexible and responsive source of network capacity than reinforcement.

We estimate the C_2C Method would deliver capacity on average 4 months earlier than traditional reinforcement. This is based on typical current reinforcement timescales of 12-16 weeks for work involving cable upgrades or switchgear, and much longer when involving new transformers or more complicated work. Customers will also not be dissuaded from triggering reinforcement by being exposed to a share of traditional reinforcement costs, which is also likely to lead to quicker project development and capacity release and utilisation across the whole network.

This quicker delivery of capacity, through the retrofitting of RTUs and actuators, will prevent delays in the connection of low carbon generation and demand to the network, and impact customers' carbon emissions. The C_2C Method will also substantially reduce emissions associated with new network assets in the period to 2030, but this is an order of magnitude less significant than the impact on customers' carbon emissions.

Since the C_2C Method delivers capacity more quickly, it is more flexible and responsive to customer needs. It means that networks will be able to more rapidly adapt to capacity requirements on specific circuits as they arise, rather than providing capacity based on annual predictions. This is important given the uncertainty in the exact mix and timescale of future decarbonisation activities (as acknowledged in the LCTP).

The potential for replication across GB
Based on the length of HV network, Electricity North West represents 6.5% of GB's distribution networks. PB's review of the C_2C concept indicated that it could be replicated to all GB's distribution networks with the exception of Central London and Merseyside/ North Wales. On this basis and excluding the UKPN's London and SP Manweb networks, this suggests that the C_2C Method could be applied to 90% of GB's HV networks, or ≈13.74 times the scale of its application to the Electricity North West HV network. We used this simple scaling factor to translate from results on the Electricity North West network to GB, rather than correcting for aspects such as customer density, customer type or mix of voltage levels.

4: Evaluation Criteria contd.

Quantifying the potential carbon contribution of a roll out of C_2C across GB

PB undertook a desktop comparison of a sample of ten projects involving reinforcement. This study compared the capacity released using current reinforcement and the C_2C Method, and the implications for assets, direct costs and losses. Appendix 7 summarises the ten case studies and Appendix 10 sets out PB's Methodology for the assessment. A summary of the selected results can be seen in the table in Section 2d. We then applied the carbon assessment methodology in Appendix 11 to PB's analysis of the ten case studies.

Appendix 11 summarises the carbon savings we estimate the C_2C Method has the potential to deliver, and provides an outline of the methodology for assessing the carbon impacts. It impacts on customers' carbon emissions (facilitated impacts), carbon impacts related to assets added to the network, and carbon impacts related to distribution network losses. The methodology and the overall impacts have been reviewed by the Tyndall Centre at the University of Manchester as suitable for providing an indicative pre-Trial view of the carbon impacts of the C_2C Method. The Tyndall Centre will work during the C_2C Project on evaluating the carbon impacts of a roll-out of the C_2C Method, as part of the Learning and Dissemination workstream.

Through scaling up the results of the case studies to GB, we can estimate the potential impact of C_2C on facilitating emissions reductions amongst our customers. This is a reduction of ≈4.8M tCO2e, based on releasing capacity 4 months quicker for customers' low carbon activities (the emissions reductions over the lifetime of the electric vehicles, heat pumps and low carbon generation would actually be an order of magnitude greater; but, we are only claiming as a benefit of the C_2C Method the emissions reductions associated with early connection).

We would also expect a more modest reduction in network carbon emissions of the order of 0.2 million tCO_2e to 2035, based on the difference between a reduction in asset carbon and an increase (more difficult to accurately predict) in losses carbon. Thus the facilitated emissions reductions for network customers would be the key carbon impact of the C_2C Project. Figure 5 summarises this.

Capacity released for customers' low-carbon activities

A full roll-out to the Electricity North West network would be expected to involve around 1 000 rings, and 2.4 GVA of capacity release. As set out above, a factor of 13.74 (based on HV network length) is then applied to scale from the Electricity North West network to the whole of GB. This suggests C_2C could release capacity on around 13 700 rings, delivering equivalent to 32 GVA of HV network capacity.

What could 32 GVA of capacity mean for helping customers realise their low-carbon plans? DNOs do not control the purpose for which network capacity is used, and cannot take full credit or ownership for the lifetime any facilitated carbon reductions. As a result, impacts on facilitated emissions have been evaluated against a range of potential low carbon uses. Suppose that the capacity is used by EVs, heat pumps or wind generation. In 2020, we estimate facilitated emissions at the scale of 0.2, 0.4 or 0.7 tCO_2e yr/kVA respectively for each of these applications, and based the benefit from C_2C Solution on enabling connection 4 months earlier than would be possible by continuing with the best existing methods. Across GB, this translates to carbon reductions of 2.6M tCO_2e if all the capacity were used for electric vehicles, or 7.8M tCO_2e if all the capacity were used for wind farms.

In practice, the capacity would be used for a mixture of applications. Taking a hypothetical case of 30% for EVs, 20% for heat pumps, 40% wind farms and 10% for growth in customer numbers, the 32 GVA of released capacity could deliver emissions reductions of ≈4.8M tCO_2e at 2020 grid carbon intensity, equivalent to 2.4% of the UK's traded sector carbon budget in 2020. Across GB, that would be equivalent to getting capacity 4 months earlier for 18M 3 kW electric vehicles, plus 25M 5 kW heat pumps, plus 6 500 2MW wind turbines.

Carbon impact of network activities

As shown in Figure 5, the impact on the distribution network's carbon emissions (associated with assets and losses) are much smaller in scale than the facilitated emissions. Yet the changes in network emissions are potentially still significant in terms of the future regulatory framework and the incentives for distribution network businesses.

Assets: Compared to building a bigger network, using automation and managed contracts would release capacity with approximately 18 times less the carbon impact from the embodied carbon of assets and their installation. This is because instead of reinforcement works involving cable upgrades, the C_2C Method only

4: Evaluation Criteria contd.

involves new network assets for automation. With 3 automated remote control points per ring, this equates to only adding less than 60 kg of new assets per ring. We estimate that C_2C deployment on Electricity North West's HV network in the period 2015 - 2035 would save some 47 000 tCO_2e network wide from reduced deployment of network assets.

Losses: The C_2C Method alters annual energy lost on the distribution network, with the carbon impacts from electricity evaluated at the grid carbon intensity. There is potential for initial reductions in losses from those circuits where the existing normal open point is optimised for quality of supply rather than losses. However in the longer term as load is increased, the C_2C Method will increase losses faster than the traditional approach to network operation. Overall compared to the traditional approach, net HV network losses from the Trial are expected to be lower with the C_2C Method for the period to 2019, then subsequently higher for the period to 2035.

Losses will increase in absolute terms for both the traditional and the C_2C Method approaches to building or releasing additional capacity, but probably more quickly with the C_2C Method (see Appendix 11 for our approach to scaling up losses from the case studies). Figure 6 shows the potential impact over time on losses on the Electricity North West network, by closing 180 rings at the end of 2012 and the remaining 880 during a three-year period from end of 2015, with loading increasing steadily over time to 2035. A similar trend would be expected for GB, but with all rollout beginning in 2015 or later.

However, the gradual decarbonisation of grid electricity will limit the overall carbon impact of increased losses. Applying the Committee on Climate Change's trend for reducing grid carbon intensity, indicates the trend shown in Figure 7 for the losses carbon impacts of a rollout of the C_2C Solution to the Electricity North West network. Comparing Figure 6 (losses) to Figure 7 (losses carbon) demonstrates how the losses carbon impacts of a rollout of the C_2C Solution to the Electricity North West network would be moderated over time by the reducing grid intensity.

We estimate that C_2C deployment on Electricity North West's HV network in the period 2015 - 2035 would increase carbon associated with losses by 31 800 tCO_2e, partially offsetting the carbon reduction for assets, to give an overall net network wide carbon reduction of 15 300 tCO_2e.

Net network impact across GB: The C_2C Method offers significant potential to reduce asset-related carbon emissions. Losses-related carbon emissions can be reduced in the short term while the grid carbon intensity is high, but would increase in the longer-term. Although impacts on losses are less certain than those on assets, we consider the net result to be a reduction in network carbon emissions.

Across GB, the difference in carbon from reducing assets installed under the C_2C Solution is estimated at 650 000 tCO_2e. The asset carbon will be saved progressively out to 2035 as reinforcement is avoided. We have good confidence in the order of magnitude of the asset carbon estimates, since the number and scale of assets is likely to scale with the number of rings and the current or MVA released.

For GB the increase in losses from a full roll-out of the C_2C Solution is estimated to 2035 at 15 GWh, or 6.4 GWh under the traditional approach. The losses carbon impacts are estimated at 942 000 tCO_2e with the C_2C Solution or 482 000 tCO_2e under the traditional approach, ie. a 460 000 tCO_2e increase. Due to the non-linear dependence of losses on loading and their relationship to changes in network topology and impedance, there is greater uncertainty in the estimates of losses over time (and therefore their carbon impact) compared to the estimates of asset carbon impact.

Has the potential to deliver net financial benefits to existing and/or future customers

The C_2C Method offers financial benefits to customers via a dramatic reduction in the cost of releasing HV capacity relative to current approaches, from £98/kVA to £16/kVA for a roll-out across GB, due to significant reductions in required network assets. This is partially offset once the costs of increased losses to 2035 and automation equipment at customer sites are included, bringing the net cost to customers of capacity via the C_2C Solution to £66/kVA. The difference or the net financial benefit to customers is thus estimated at £32/kVA. The C_2C Project will ascertain that the capacity that can be safely and sensibly released.

Method Cost and Base Case costs at the scale of the Project

Our estimates of the net financial benefits to customers use the results of ten case studies analysed by PB (see Appendix 8). These case studies can be considered to reflect the most efficient methods currently

4: Evaluation Criteria contd.

available, since they are current connection and general reinforcement projects which have been approved or are currently going through our internal approval processes. For clarity, total costs over the period to 2035 are shown without any discounting and without any inflation adjustments for the costs of delivering network assets.

C_2C Method Costs: The ten case studies suggested that applying the C_2C to release 50% of available capacity would deliver on average 3 MVA/ring at 11 kV and 2 MVA/ring at 6.6 kV. In the Trial, the circuit selection methodology in Appendix 10 indicates that we will consider 90 circuits at 11 kV and 90 circuits at 6.6 kV. This suggests total capacity release of 454 MVA (271 MVA at 11 kV and 183 MVA at 6.6 kV).
The main part of the network cost of the C_2C Method varies with the number of rings created, based on adding typically three remote control points per ring, plus a small amount of cable upgrade in some circumstances. For the case studies, this suggests an average direct cost of £22 000/ring. Once appropriate overheads are included to reflect the new volume of reinforcement work, this suggests a total cost of £6.6M for adding automation and minor reinforcements.

To identify the total network cost with the C_2C Method, the cost of enabling systems must be added to the cost of automation and minor reinforcement works. For the C_2C Project, Electricity North West proposes a light integration of GE's PowerOn Fusion software module with our existing control room management system. This light integration is appropriate for a trial and could be scaled up to a slightly wider number of circuits. However this would not be the enduring solution once the C_2C Method had been proven successful.

On the timescale for comparison to 2035, the most efficient and secure approach would be to fully integrate the C_2C Method's functionality as part of the distribution network management system. Given Electricity North West's existing systems, this integration might need to occur as part of larger ~£10-15M project to renew and upgrade its complete network management system (subject to other business and technical considerations). In this situation, the marginal impact of adding the C_2C Method's functionality is estimated at £1M above Base Case. Ongoing support costs are estimated at £1.3M over the period to 2035 (£65k/yr over 20 years).

Contracted C_2C customers will need to have remote control capabilities at their sites, to manage their demand down to supportable levels during the post-fault restoration period. These costs are estimated for 1800 contracted C_2C customers (ie. 10 per ring in the long-term, although fewer during the three-year Trial, 0.2-0.3 MVA of managed response each). The average cost is estimated at £5 000 per remote control point over the period to 2035. This suggests contracted C_2C customers would bear an additional £9M to participate out to 2035 (set in the context of the overall net cost reduction).

The increase in losses due to increased loading on the Trial circuits would add £20.6M of cost to customer bills (via their suppliers) over the period to 2035 (relative to the current level of losses). This is based on closed rings at the end of 2012 and the released capacity being progressively used up to 2035. The cost of losses to customers is assumed to start at £60/MWh in 2010/11 (DNO incentive rate from the latest price control review) then follow the same increasing trend as suggested for the `variable industrial' supply costs in Table 4 of DECC's Interdepartmental Analysts Group's 2010 publication 'Valuation of energy use and greenhouse gas emissions for appraisal and evaluation'.

On the scale of the Trial but once the concept is proven (rather than including all innovation and dissemination costs), this gives a total network cost of £8.9M with the C_2C Method, plus £29.6M of other costs to customers as detailed above, giving a total Method cost of £38.4M to 2035.

Base Case Costs: The case studies were used to indicate how the 454 MVA of capacity delivered by the C_2C Method could be delivered using traditional methods (271 MVA at 11 kV and 183 MVA at 6.6 kV). Amongst the case studies, there were 8 projects where current was the limiting factor in terms of traditional capacity delivered (on average 5.6 MVA/ring at 11 kV or 3.5 MVA/ring at 6.6 kV) and two much larger projects where transformer capacity was the limiting factor (on average 5.7 MVA/ring). Reinforcement involving addition of a 23 MVA primary transformer, either new or replacing a smaller transformer, is much rarer and more expensive than reinforcement simply involving cable and switchgear upgrades. The C_2C Project is able to provide the most significant cost savings relative to traditional reinforcement in these cases; however due to their rarity, they need to be a given a low weighting in terms of estimating the total costs of delivering capacity by traditional methods. We set this weighting factor at 3%, equal to the proportion of the total number of actual and expected HV reinforcement projects involving new or replacement primary transformers on our network over the period 2009-2015. Since larger assets are more costly and deliver more capacity, we chose to express the traditional cost metric in £/kVA. Based on the case studies, the

4: Evaluation Criteria contd.

average total direct reinforcement cost of traditional approaches is expected to be £43/kVA at 11 kV or £72/kVA at 6.6 kV. Scaling up to the required capacity levels in MVA, and adding current overhead levels within Electricity North West, suggests network costs in the Base Case of £41M to 2035. Due to increased loading, the costs of losses to customers are expected to also increase by £8.8M in the Base Case.

Summary of benefit analysis: The net difference between the Method and Base Case costs (the net financial benefit to customers) is thus £11.4M, based on a £32.1M reduction in network costs, combined with a £20.8M increase in non-network costs to customers (associated with losses for all customers and C_2C customers' automation equipment).

Customers would receive the £32.1M reduction in network costs in a mixture of three ways:

1. Reduced future requirements for general reinforcement at HV (funded by customers in general, via future price controls).

2. Significant reductions in the customer portion of connections-driven reinforcement for customers contracting under the C_2C Solution.

3. Demand response and generation response payments to customers contracted under the C_2C Solution.

The C_2C Project will allow us to quantify the magnitude and timescale of these three types of benefits to customers, but we consider that reducing the future growth in costs of general reinforcement at HV would be the primary benefit and most tangible benefit to customers. Due to the complexities of making a rigorous carbon valuation and the uncertainties over who bears such costs, the cost of carbon has not been included in the above analysis. This will be addressed in the Project.

Potential for replication and benefits across GB

We have assessed the potential benefits of replication across GB by first assessing the potential for the Electricity North West network, then scaling this up to GB. This is similar to the way that asset-related carbon costs are scaled up.

There are 2 935 circuits on the Electricity North West high voltage network, of which about 150 are interconnectors. It takes two feeders to form a ring ie. 1 392 potential rings. The technique would not be applied to poorly performing circuits with high fault rates, or to circuits where creating a ring would lead to high initial increases in losses. This reduces the number of potential rings to around 1 000. 33% of HV circuits on the Electricity North West network are at 11 kV, so it is assumed that 330 rings are formed at 11 kV and 670 rings at 6.6 kV.

Scaling up to the Electricity North West network using the same approach for deriving capacity released and its costs as was applied above to determine the Base Case and Method Costs on the scale of the Project, this suggests C_2C could deliver capacity of 2 400 MVA. In the C_2C case, this would be associated with £38.7M of network costs, £66.6M of net losses impact and £50M of costs for remote control equipment at customer sites; the total C_2C cost would be £155M to 2035. In contrast, a traditional network reinforcement approach to delivering the same capacity would be expected cost £273M to 2035 on the Electricity North West network. This suggests a net financial benefit to customers of £118M from applying the C_2C Solution to the Electricity North West region.

Based on the length of HV network, Electricity North West represents 6.5% of GB's distribution networks. PB's review of the C_2C Method indicated that it could be replicated to all GB's distribution networks with the exception of London and Merseyside/ North Wales. On this basis and excluding the UKPN and SP Manweb networks, this suggests that the Method could be applied to 12 DNOs covering 90% of GB's HV networks, or ~13.74 times the scale of its application to the Electricity North West HV network. It is also evident from our initial work that the C_2C Method could be applied to those elements of both the SP Manweb and UKPN's London HV networks that are of a more traditional design and can be applied to their EHV networks. We use this simple scaling factor to translate from results on the Electricity North West network to GB, rather than correcting for aspects such as customer density, customer type or mix of voltage levels; these aspects could be considered during the Project.

For DNOs in general, the full integration of the C_2C Solution's functionality in a network management system could happen in one of two ways, either as part of a larger project for renewal and upgrade of a complete network management system, or by purchase of a C_2C Solution module which is designed to integrate with

4: Evaluation Criteria contd.

an existing network management system. From their participation in the Project, GE is likely to be able by develop their network management products to offer both options to integrate the C_2C Solution's functionality. Since GE network management systems are already used by other DNOs, addition of a C_2C Solution module is an obvious delivery route for the replication of the C_2C concept across GB. In this situation, we estimate the marginal cost to be of the order of £0.5M, per DNO area.

Assuming that Electricity North West integrates the C_2C Solution via a new network management system but the remaining 11 DNOs integrate the C_2C Solution via a module adding to their existing GE network management system, this gives a total marginal system set up cost across all twelve DNOs of £6.5M. Ongoing support costs per DNO area are estimated at £1.3M over the period to 2035 (£65k/yr over 20 years). We estimate that the C_2C Solution could deliver around 32 GW of HV network capacity across GB by 2035, at a total cost to customers of just over £1.6Bn (£0.53bn in network costs, plus £0.69bn for remote control equipment at C_2C customer sites plus £0.91bn for the net cost of increased losses,). The C_2C Solution would reduce the cost of losses to customers in general up to around 2019, but then increase the amount of electricity lost on the distribution system after around 2020 (see Figure 6).
In comparison, this scale of HV network capacity could still be delivered by current techniques, but at a network cost of £3.2Bn to 2035 in current prices. Relative to the C_2C Method, the capacity would also be delivered more slowly and with greater disruption to customers. Thus the C_2C Method offers net financial benefits to existing and future customers of just over £1Bn, plus the indirect financial benefits of the accelerated transition to a lower carbon economy and of reduced disruption associated with installation of new network assets.

Level of impact on the operation of the Distribution System

Network operators will be expected to meet the expected increases in network capacity in the most economical and efficient manner. Whilst there may exist isolated cases of strategic network reinforcement utilising traditional methods, it is expected that DNOs will need to explore options for further increasing the utilisation of existing assets via use of a range of smart techniques; many of which push the boundaries of what is currently considered as best practice in the design and operation of distribution network.

The C_2C Project has the potential to have a very significant affect on the operation of distribution networks in the UK. The release of available capacity to both customers via use of a combination of system automation and demand side response represents a true step change involving network users in the operation of the network. However, the price to be paid for the increased asset utilisation afforded by the use of this technique will be an associated increase in the operational complexity of the distribution network; particularly in respect to the potential interaction of demand side response contracts and the economic considerations with the utilisation of that response. The sophistication of the automation algorithms in a DNO's network management systems will require a much more rigorous assessment of the effects of new connections and a better understanding of the capabilities of these new systems as well as the acceptability of their use in securing supplies. DNOs have developed such complex functionality for the delivery of significant improvements in Quality of Supply to customers and the challenge whilst complex in some details is a relatively simple extension of this existing technology.

DNOs will require software tools which allow them to assess in real-time the economic and system trade-offs associated with the utilisation of demand side response to manage constrained networks. To ensure that network operators understand what is acceptable in terms of the future operation of networks it is necessary to develop standards which specify their requirements, particularly how operationally risks are appropriately mitigated.

It is necessary to develop new industry policy to define an appropriate operating risk envelope for both the future operational and planning time horizons. Existing planning standards can in many situations specifically preclude the use of smart techniques, such as the C_2C Method, to solve potential network constraints associated with the connection of new loads and generation.

This is a key challenge for the industry and the networks businesses as they facilitate the transition to a low carbon economy. The C_2C Project aims to explore the early evolution of the existing planning standards so they can accommodate techniques such as the C_2C Method. The emphasis will be on the issues that relate to use of the C_2C Method such as the contribution to network security from network automation, load transfers and demand side response. However, many of the questions considered have clear parallels with the adoption of other techniques and as such the learning will be very applicable to the industry as a whole as it seeks to develop new standards.

4: Evaluation Criteria contd.

Electricity North West and PB will undertake a review other standards in use for applicability to the C_2C approach and seek to identify current best practice. It is proposed to run workshops with key internal stakeholders on current practice used elsewhere and to develop initial proposals for the planning and operation of future networks incorporating use of techniques such as those included within the C_2C Method. This will include the appropriate assessment of information and data coming out of trial, on implications for future planning standards and operational procedures and the refinement of the initial proposals. A report will be produced by PB outlining the issues and making a number of recommendations. It is also proposed to run a workshop with ENA and other UK DNOs. The terms of reference of this work is expected to include the following:

- Identify existing policy and practice and other industry documentation which is relevant to the development of a future operating methodology (including GB SQSS, original OM1 and OM3 incorporated into SQSS and ER P2/6).
- Set out the range of operating regimes from both an asset and customer perspective, and define acceptable responses to events that directly affect assets or customers or pose risks to assets or customers.
- Examine the extent of the current and future uses of network automation solutions including potential rules for use of network auto load transfers including consideration of the implication for the transmission operator.
- Explore issues of network resilience and in particular the lower range of acceptability where resilience is not provided solely by traditional infrastructure means.
- Explore the use of techniques such as generation and demand side response to manage networks loadings and constraints in both planning and operating time horizons.
- Explore and articulate the industry drivers for development of an operating standard.
- Explore the implications of the introduction of operating standards on existing design standards and consider their potential future integration.

Generates knowledge that can be shared amongst all DNOs

The C_2C Project will generate incremental learning in a number of key areas; this will be of particular interest to other DNO's and in many cases will feed into the discussions for RII0-ED1.

Customer Engagement and Segmentation: Develop methodology for segmenting customer base for Demand Side Response sales approach. This will also provide new information on how to best engage with customers and what are the most appropriate channels to market for new commercial arrangements. The learning will inform how to market propositions to both new connections customers and existing customers. The knowledge will inform how DNOs can best incorporate C_2C customers into the future running of the network.

Demand Side Response: Develop new commercial offerings and understanding of willingness of customers to engage in demand side response contracts and test different channels for customer engagement for the provision of demand side response. Specifically during this trial we will be gauging the appetite among new and existing customers to engage in post fault demand contracts which seek to delay restoration customers or limit their usage following a fault. The Trial will also inform us the prices at which existing customers are willing to engage in Demand Side Response contracts.

Network Planning & Design Standards: One of the key outcomes of the C_2C Project will be to generate new network design and operating procedures. Network simulation will help us to understand the extent of the capacity release that the C_2C Method can safely deliver. These may be utilised as the change proposal for updating the existing ER P2/6 and/or developing a DNO operating standard (similar to SQSS for transmission networks).

System Performance: During the course of the C_2C Project we will generate data and knowledge of the impact on power losses, power quality, network utilisation and standards of performance. Losses in transmission and distribution networks represent the single biggest use in any electricity system, in Europe they consume between 4 and 10% of electricity generated (http://www.leonardo-energy.org/drupal/node/2935) and thus generating learning that may impact this is critical. Power quality will look at a number of different aspects including; continuity of service, variation in voltage magnitude, transient voltages and currents and harmonic content.

Network Management Systems: The C_2C Project will seek to create an enhanced and transferable control and automation system for adaptive network management. The learning that comes from this will be of critical importance in the future of network management and as the regulatory system changes.

Economic and Carbon Modelling: The Project will inform the development of carbon and economic models which will allow a DNO to assess the impacts of the Solution on its own network. The learning from the modelling work will inform Ofgem and other DNOs of the impact that the C_2C Method can have on an operators networks in terms of carbon savings and customer benefits.

4: Evaluation Criteria contd.

Involvement of other partners and external funders

GE Energy: GE Energy is one of the world's leading suppliers of power generation and energy delivery technologies.

Prior Experience Brought to Project: GE Energy has extensive experience gathered from implementing energy network management systems. Its UK footprint controls 90% of transmission and distribution networks. GE Energy offers a suite of services and products across the Smart Grid including both hardware and software solutions. As a truly global company GE Energy can draw from experience and knowledge that was acquired in projects from around the world.

Role on Project: GE Energy is a lead technology provider and will supply a network management capability, integrated into Electricity North West's current operating environment that will enable Electricity North West to achieve the desired goals. In addition to that GE Energy will provide Project management and implementation services as well as assist Electricity North West to design and develop required interfaces to existing systems.

Parsons Brinckerhoff (PB) Ltd: PB is experienced in all aspects of power generation, transmission and distribution, and have particular expertise in the regulatory and restructuring aspects of the industry.

Prior Experience Brought to Project: PB was the project manager for consortium bid to DTI/TSB on `A Novel Smart Grid Solution for Active Management of Distributed Generators using Real-time Thermal Ratings', they then project-managed the consortium and provided engineering support to Scottish Power. This was a 3.5 year project which was successfully completed, and won a 2010 IET innovation award. PB also has worked extensively with Electricity North West on system planning, connections and network design.

Role on Project: PB will be responsible for engineering planning and design and ensuring the network operating techniques developed in the C_2C Project are transferable to other DNOs. PB will provide design resource and support on connections activity; develop a series of recommendations to the industry for development of standards, delivered through industry workshops.

Flexitricity: Flexitricity developed, owns and operates the UK's largest advanced smart grid system. Flexitricity provides demand response to utility clients by aggregating flexible consumption and generation at I&C sites.

Prior Experience Brought to Project: Flexitricity has supplied demand response by aggregation to National Grid for three years, and was the first company to do this on an open-market basis. Flexitricity is a delivery partner for one of last year's successful Tier Two Projects, where I&C demand response will be tested mainly in pre-fault scenarios.

Role on Project: Flexitricity will be providing a post-fault demand response service at I&C sites in Electricity North West's area including: Assessment of demand response potential, installation of metering and load control equipment, management of customer participation, demand response dispatch and settlement.

EnerNOC: EnerNOC develops and provides energy solutions to institutional, and I&C customers, as well as electric power grid operators and utilities.

Prior Experience Brought to Project: EnerNOC participated in Electricity North West's first LCN Fund bid, as well, offering a combined demand response/energy efficiency service to a number of Electricity North West customers in the Corridor Manchester. In addition, EnerNOC helped to develop and is currently a part of one of last year's successful Tier Two Projects.

Role on Project: Same role as Flexitricity above.

npower: npower is a leading integrated UK energy company.

Prior Experience Brought to Project: Experience in demand response market. They are a commercial aggregation service provider to NG. They hold a strategic partnership with Flexitricity delivering SmartSTOR solutions to businesses.

Role on Project: npower will support the work of EnerNoc and Flexitricity in identifying customer groups and segmentation activities as well as in the development of the new commercial arrangements.

National Grid Electricity Transmission (NGET): NGET owns and operates the National Grid high-voltage electricity transmission network in England and Wales.

Prior Experience Brought to Project: NGET has been actively in LCN Fund for the last 2 years. They were Project Partners on the a number of winning bids in the first round of funding and are playing an active role in a number of this year's submissions. NGET aids development of a number of electricity industry codes.

4: Evaluation Criteria contd.

Role on Project: NGET to actively contribute to the discussions on the redrafting of ER P2/6 and/ or development distribution SQSS equivalent. NGET will input into the development of the conclusions and dissemination of the finding on the Demand Side Response customer survey and customer participation.
University of Manchester: The University of Manchester has a very high quality research profile and is counted among the leading universities in the world and one of the UK's leading Schools of Electrical and Electronic Engineering for both teaching and research.
Prior Experience Brought to Project: The Electrical Energy and Power Systems Group have expertise in power system analysis, dynamics, power quality, and economics as well as specialist skills in power system protection and power system plant (utilising the largest University HV lab in the UK). The well-respected Tyndall Centre for Climate Change Research at the University will support the carbon impact assessment work within the C_2C Project. Tyndall brings together scientists, economists, engineers and social scientists who are working to develop sustainable responses to climate change.
Role on Project: The work carried out by the academic partners will see the development of network models which are based on known network data using the data being generated by the monitoring equipment on within the trials. The network models will be used to run a range of studies consisting primarily of power flow incorporating losses, fault and harmonic analysis. These will be used for a range of purposes including: Assessing the capacity that can be released through the closure of an open point in conjunction with management contracts; informing an assessment of the carbon benefits of the Project; informing the development of an economic model for the Project.
University of Strathclyde: The latest UK Government's Research Assessment Exercise affirmed the University of Strathclyde's status for "world-leading and internationally excellent" research, rating it top in Scotland, by a long way, and 3rd in the UK. The University has Europe's first research centre dedicated to the development of 'smart' technologies.
Prior Experience Brought to the Project: Strathclyde have been involved in a number of relevant EPSRC Supergen Programmes including: Supergen I,III and V: Future Network Technologies, Highly Distributed Power Systems, Energy Storage; Wind Energy Technologies.
Role on Project: See above. ***(The Project Partner `eco system' can be seen in Figure 8.)***

Relevance and timing

Relevance

Previous Second Tier Low Carbon Networks Fund Projects are considering the impact on the low voltages networks and the mitigation techniques for managing the new demands. Instead the C_2C Project targets the operation of the HV and EHV distribution networks with the aim of significantly reducing the need to reinforce these networks in times of increasing demand as outlined in the Problem definition above.

Innovation

Innovation within the C_2C Project is driven across the three areas of: Commercial development, Technological development and Operational development. The C_2C Project will use, in a different context, the system automation algorithms, previously developed by Electricity North West for driving network performance. The experience gained in developing and utilising these control algorithms means we have a high degree of confidence in adapting this technology for the C_2C Project. The use of demand side response and generation side response at distribution network level is at an embryonic stage of development in the UK. The specific technology is mature in particular applications, however new applications will require innovation. In essence the C_2C Project explores the innovative application of a mature technology. The combination of the developments in control systems and in demand side response contracts in this manner takes us the next step towards a system operator role, which is a potential requirement in the future. A key learning outcome from the C_2C Project will be the drafting of a new design and planning standard, whether to inform the amendment or replacement of the existing Engineering Recommendation.

Impact on next price control

The learning from the Project could have significant impact on RIIO-ED1 arrangements and the business model for DNOs. The C_2C Project will run from January 2012 to December 2014 and throughout its lifecycle we will feed our findings and conclusions into the price control discussions. One of the key outcomes for the C_2C Project that will shape RIIO-ED1 is how and too what extent distribution network operators can utilise demand side response opportunities to assist in the management of the network in both the operational timeframe and in the planning timeframe thereby deferring reinforcement in the longer term.

4: Evaluation Criteria images, charts and tables.

Figure 5: Carbon impact of C_2C Method across GB
Calculated to 2035
tCO_2e

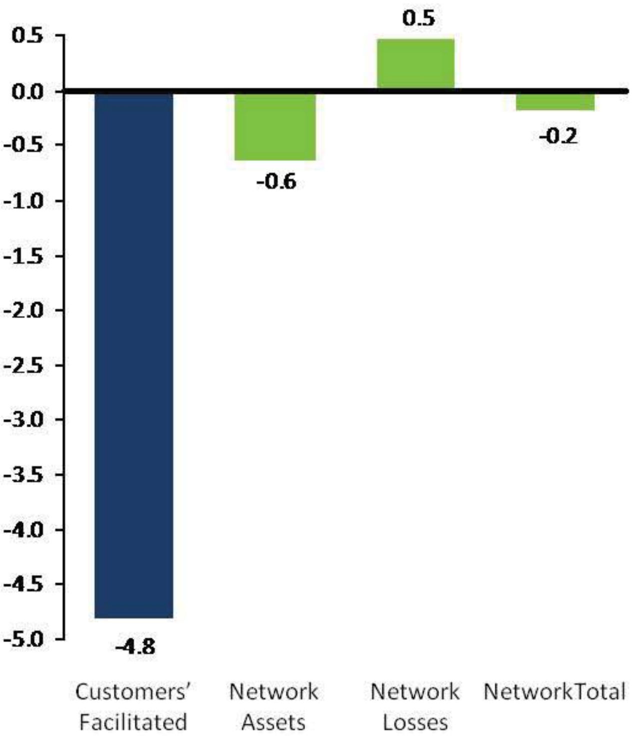


Figure 6: Losses trend over time for traditional vs. C_2C Method
Trial plus roll out across ENWL network, MWh/yr

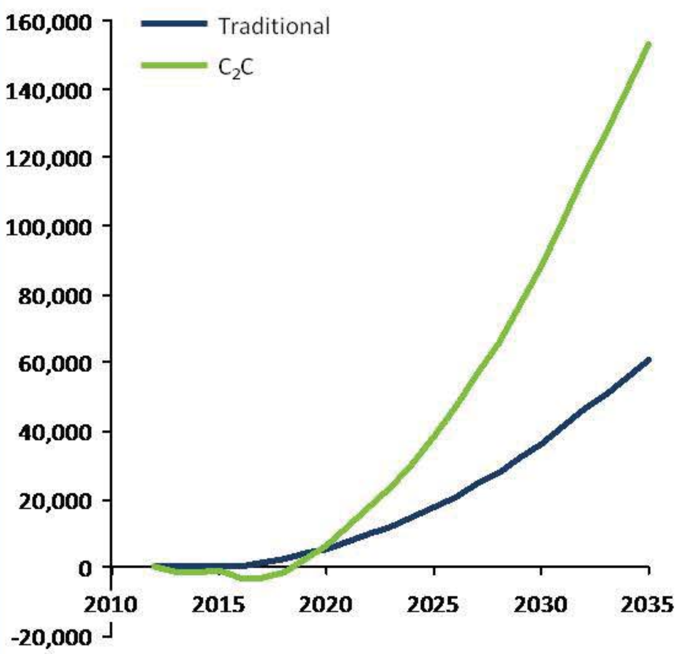


Figure 7: Losses carbon trend over time for traditional vs. C_2C Method
Trial plus roll out across ENWL network, tCO_2e /yr

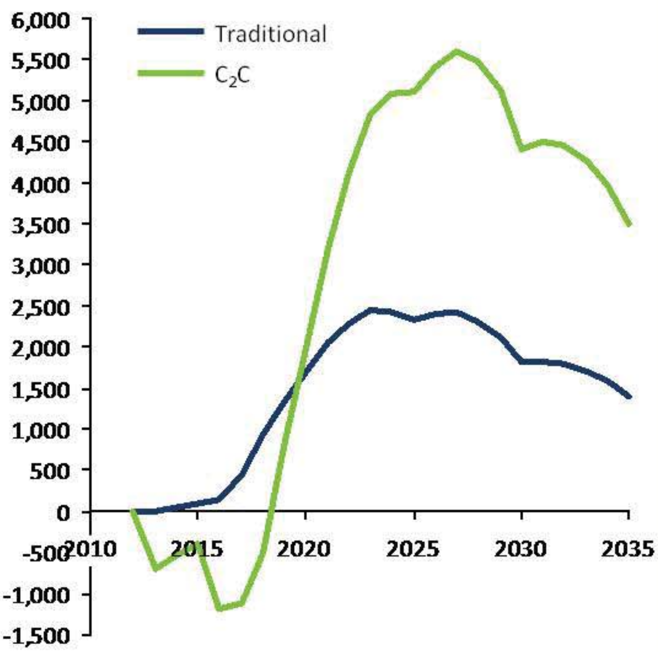


Figure 8: Project Partner 'Eco System'

Evaluation Criteria Images

Section 5: Knowledge dissemination

☐ Put a cross in the box if the DNO does not intend to conform to the default IPR requirements

"We will generate significant knowledge that, through a structured dissemination approach to a range of stakeholders, will inform discussions on RIIO-ED1"

Knowledge dissemination will be at the heart of the C_2C Project. It's imperative that all learning and insights are shared not only with the academic and industry community but also with customers and other interested parties. In order to ensure this happens our dissemination approach will be pragmatic and identify the most suitable dissemination methods for the various stakeholders.

Audience

We see our main audience/stakeholders as being broken down into the following categories:

Customers: Disseminating information to customers will form a crucial part of the dissemination agenda. There will be a variety of end customers that we will need to address, these will not only include industrial and commercial property owners but also local authority developers, generator developers and operators and other network operators. These customers will be interested in the learning from the contractual agreements that we are set to develop in collaboration with the demand response partners. The Trial will provide an important opportunity to start engaging with end customers and providing education about demand response solutions. Achieving customer buy in will be critical to the success of the C_2C Project.

Electricity North West: Knowledge will be shared and discussed with the C_2C Project team and wider Electricity North West community. They will be interested in all aspects of the Project and working to establish how learning/ knowledge will be incorporated into future business as usual.

Industry participants: This will include the other DNOs, IDNOs, the suppliers, aggregators and generators, especially renewable generators. In the case of network operators their interest will be on how they can apply the lessons learn to their own networks. The suppliers and aggregators will be keen to understand the success of the demand response solution and understand the potential to apply it to their own customer base. Renewable generators will want to understand how they can more cheaply and efficiently connect to the network.

Academic institutions: This includes all universities and higher education facilities that have expressed an interest in the C_2C Project. Their primary interest will lie in the raw data that will be collected throughout the C_2C Project and how they can use the outputs/ conclusions from the C_2C Project in further studies/ research activities. They will also be interested in the philosophy of system design.

Industry groups: This will include various industry groups such as the Energy Networks Association (ENA), the Combined Heat and Power Association (CHPA) D3 stakeholder initiative, the Association of Electricity Producers (AEP) and Smart Energy Demand Coalition (SEDC). Their primary interest will be with new network design and operating standards, system configurations and demand and generation response agreements.

Government and Regulator: DECC and Ofgem will be interested in not only receiving the results of the trials and the key findings and recommendations but also feedback on the overall C_2C Project experience and any lessons learnt that can be feed back into future innovation projects and mechanisms.

Local groups: There will be interest from a number of other local groups including Local Enterprise Partnerships, local councillors, business leaders, Chambers of Commerce, Greater Manchester Energy Group and various policy makers.

Dissemination Approach

Our approach will be simple, targeted and tailored. In order to address each of these groups we have developed a number of dissemination approaches. They are designed not only to distribute the learning but also in some cases provide a feedback mechanism that will allow the Project to develop further and produce better results. The following are our proposed approaches:

Company briefings: Internal team briefings will be held throughout the C_2C Project to ensure the lessons learnt are shared across the Project team and within the wider Electricity North West community. This will be managed by Directors who will maintain responsibility for dissemination within their respective teams. Regular updates will also be included in the new internal company magazine, NewsWire. The information

5: Knowledge dissemination contd.

that is disseminated internally will also inform policy decisions that are made throughout the period of the C_2C Project.

Intranet*:* Monthly updates within the company intranet site. This will ensure that knowledge is disseminated within all areas of the business.

C_2C Project website*:* The C_2C Project website will form the hub for the dissemination approach. It will be the repository for all C_2C Project information and key reports and findings. It will be split into a number of sections and the information the user sees will be based upon where they declare they are from ie. academic users will see different information than customers. The website will include a database for all research data as well as periodic updates and white papers throughout the course of the C_2C Project. Electricity North West will work with UoM and UoS to understand what the most appropriate and user friendly way to host this database will be and how we can create the most value from it. Electricity North West will also seek to partner with websites such as: *www.consumerfocus.co.uk*, *www.meuc.co.uk* etc who have greater exposure to customer groups and can provide links to the website and key findings.

Forums/ Panels*:* We plan to establish collaborative focus groups and panels with representatives from the various stakeholder groups. The purpose of these forums will be to allow people to challenge findings and provide a two way question and answer debate between the C_2C Project team and outside experts. These will occur throughout the duration of the Project, creating a feedback mechanism to drive the Project forward. One key forum will be the customer forum which will allow us to test findings and build engagement.

Lectures and conferences*:* We are proposing to present the final findings of the C_2C Project at 5 conferences at the end of the Project. These will be in different areas within the industry and will be discussed with Ofgem within the last year of the C_2C Project. They could include: IEEE Innovate Smart Grid Technologies, Smart Grids Summit and IET Smart Grids. One key conference which will be targeted for dissemination throughout the life of the C_2C Project is the annual LCN Fund conference.

Journal articles*:* The C_2C Project will seek to publish a number of articles within peer reviewed journals on various aspects of the Project from the carbon impact and demand response to new network designs.

Six monthly progress reports: These reports will be directed at Ofgem (and DECC) to provide feedback on progress. These reports will be focused on the overall Project delivery and consortium approach to provide Ofgem (and DECC) with learning that will help in future LCN Fund type programmes.

Lessons learnt reports: These reports will be directed at stakeholders to provide feedback on aspects such as what is going well, how not to do things etc. These reports will be focused on the overall Project delivery and consortium approach. These will be provided quarterly throughout the C_2C Project.

Close out Conference: Final close out conference with all interested parties to present to key findings and white papers as well as lessons learnt and suggestions for next steps and future business.

Press releases: The Electricity North West press office will release a series of press statements throughout the course of the Project

External visitors: Electricity North West will be open to welcoming external visitors to view the C_2C Project and discussing the outcomes and progress made.

Taking into consideration the above areas, and to ensure that we are providing the right groups with the right information we have defined the key deliverables that will be generated throughout the course of the C_2C Project. These have been derived from the Project milestones and at this stage represent examples of the key documents that will be disseminated throughout the C_2C Project. This can be seen in table 3.

Management and Timing of Dissemination

Dissemination will be managed through the Learning and Dissemination workstream. Along with press communications its role will be to ensure that the right deliverables are made available to the right audience through the methodologies discussed above. Timing of dissemination will also be managed to ensure that people receive regular C_2C Project updates and knowledge as and when it is gained throughout the C_2C Project. It is the intention of Electricity North West to distribute at least one piece of key learning every 6 months in addition to forums and stakeholder panels and website updates. The majority of learning will be disseminated in the latter stages of the C_2C Project once all the data has been analysed and conclusions drawn, as is only appropriate. Due to the quick and simple nature of the C_2C Solution this learning schedule

5: Knowledge dissemination contd.

should allow DNOs to digest the knowledge in time to inform discussion for RIIO-ED1.

Overall Approach

By putting all of the above elements together we are able to produce a pragmatic, succinct targeted approach to dissemination, making sure that the right information is delivered to the right audience in the appropriate manner. This can be seen in table 4. In conclusion the C_2C Project's approach to dissemination is rigorous, cost effective and targeted. It delivers the right knowledge to the right people throughout the course of the C_2C Project by utilising a series of targeted, low cost and low resource channels.

5: Knowledge dissemination images, charts and tables.

Table 3: Project deliverables for dissemination

Milestone	Description	Deliverable	Responsibility
Technical Development	Completion of Power on Fusion and ENWL Network Management System (NMS) configuration and new system controls	Technical documentation of NMS configuration. Description of operating mode of load management algorithm. Specification for customer database supporting DSR / GSR operations i.e. MINIMUM functionality of DR1000 module	GE/ Project team
Network Design	New network design and operating procedure	Technical documentation of new network circuit design (PB) Assessment on the scope/applicability of concept (PB) Simulation results for boundary point for use of concept (UoS) Levels of discount applied at EHV to ensure security of supply.	PB / Project team/ UoS
Circuit Selection	Completion of circuit site surveys and selection of rings for trial and hardware installation	Description of ring selection methodology – which circuits we choose and why.	PB / Project team
Customer segmentation	Full customer segmentation to understand the customer willingness and potential to adopt new kinds of arrangements within their geography	Documentation of: • Customer segmentation approach • Customer segmentation results	EnerNOC/ Flexitricity/ npower
Customer surveys	Completion of customer survey among representative group of customers ranging from small commercial premises to industrial facilities to understand appetite for DR	Customer survey results: • Pricing and terms • Level of interest • Key enablers	Project team/ EnerNOC/ Flexitricity/ npower /
Commercial templates	Development of commercial arrangements and contracts for target segments based on segmentation and survey results	Set of commercial templates designed for individual customer segments	EnerNOC/ Flexitricity/ Npower/ Project team
Network Data analysis	Full network data analysis complete and conclusions reached. Analysis of losses, power quality, network utilisation and standards of performance.	Full set of raw data within project database. Analysis of losses, power quality, network utilisation and standards of performance	UoS/ UoM
Economic modelling	Economic assessment of C_2C concept vs. traditional approach(es)	Assessment Report	UoM/ UoS
Carbon assessment	Carbon impact of C_2C method	Assessment of carbon impacts on region and potential roll out across the ENWL region and Great Britain	UoM/ Tyndall Centre Manchester
Dissemination	External publishing of results and key findings, industry seminar to share learning's	Set of white papers with in depth project findings ranging from carbon impacts to network design	Project team/ GE/ PB / UoM/ UoS
Project decommissioning	Removal of hardware from selected survey and removal of GE's NMS	Documentation on decommissioning approach	Project team/ GE

Table 4: Dissemination approach

Audience	Dissemination Methods	Deliverables
ENWL	Company briefings, intranet site	*All key deliverables*
Industry Participants	Project website, forums & panels, seminars, journal articles	Technical documentation of NMS configuration, Technical documentation of new network circuit design and operation, Description of ring selection methodology, Documentation of hardware installation methods/requirements, Customer segmentation approach, Set of commercial templates designed for individual customer segments
Academic Institutions	Project website, forums & panels, seminars, journal articles	Full set of raw data within project database, Set of white papers with in depth project findings ranging from carbon impacts to network design
Industry groups	Project website, forums & panels, seminars, journal articles	Technical documentation of NMS configuration, Technical documentation of new network circuit design
Ofgem/DECC	Project website, seminars, lessons learnt reports, close out conference	Lessons learnt, Set of white papers with in depth project findings ranging from carbon impacts to network design
End customers	Project website, forums and panels	Set of white papers with in depth project findings ranging from carbon impacts to network design
Other	*All of the above depending on individual or group*	*Various*

Knowledge dissemination images

Section 6: Project readiness

Requested level of protection require against cost over-runs (%). 0%

Requested level of protection against Direct Benefits that they wish to apply for (%). 0%

"By applying proven technology in an innovative manner, engaging with diverse customer groups and experienced partners we have a high degree of confidence over delivery"

Bringing together a number of different aspects allows Electricity North West to start the C_2C Project in a timely manner. These are discussed in more detail below but essentially can be summarised as the following:

- Strong consortium of partners, bringing together the best in the industry
- Substantially pre-developed technology by GE and Electricity North West provides a strong foundation to build on
- Support from potential customers and local business groups
- Thorough programme governance and experienced Project management structures
- Internal approval from investors and strong senior management support

Consortium

The key to success in the delivery of the C_2C Project is the selection of the relevant Project Partners and the building of a strong consortium. Selection of our preferred partners was undertaken by the Electricity North West Future Networks Steering Group via a presentation and selection process, culminating in the appointment of the preferred partners into the Project. We have developed the partnerships into a position where all our partners have a detailed understanding of the C_2C Project requirements, their key deliverables and responsibilities within the Project plan. The continuing dialogue with partners regarding the timing, costs of provision of services and equipment, involvement and funding of personnel and agreeing the overall levels of investment provide a high degree of certainty and robustness to the Project Plan, outlined in Appendix 2. All partners are signatories to a consortium agreement (see Appendix 12) that ensures explicit recognition and commitment to the project requirements. The one exception to this is GE, who do not sign such agreements as a matter of company policy. In their case we have worked closely with GE to design the C_2C Project and they have an intimate knowledge of the C_2C Method and C_2C Project plan. A specific Memorandum of Understanding covers their substantial commitments to the C_2C Project, which have a value of £0.39 million. Each of the Project Partners is off sufficient size that dedicated resources have been seconded to the Project, mitigating any risk of partner delivery. We are planning all the preparation steps prior to the LCN Fund award so that we can mobilise without delay.

Programme Management and Governance

The purpose of the governance structure is to ensure the C_2C Project's program meet the delivery criteria and Project milestones through timely and effective decision making, resolution of issues and mitigation of risks. Ultimate Project direction will come from the Project Director, Mike Kay, Network Strategy Director of Electricity North West, however key decisions and sign off will be supported by a Project Steering Committee. The Committee will be staffed by representatives of the various Project Partners and will help guide the strategic direction of the Project. The Committee will sit above the Programme Management Office (PMO). The C_2C Project will be managed by the PMO, this will be manned and run by Electricity North West. The PMO will report to the Project Steering Committee comprising senior management from Electricity North West and senior members from key Project Partner organisations. Below the PMO will be the individual workstreams who will perform the tasks outlined in the Project plan under the governance of the PMO. There will be two dedicated Electricity North West resources who will manage the activities of these 4 workstreams. The programme governance structure can be seen in Appendix 2.

The Project will be subject to robust governance and management, ensuring stakeholder sign-on prior to the commencement of the Project and continuing communication and reporting as the C_2C Project progresses. All reporting will be based on a RAG (Red, Amber, Green) status against all key objectives including schedule, budget, deliverables and learning capture. Such rigorous PMO and sign off activities should ensure that costs won't over run the estimates outlined in the bid.

6: Project readiness contd.

Project Plan

The Project plan sets out the approach that the C_2C Project team has determined will bring the highest success. The PThe first section involves the mobilisation of the internal and external teams and the technical development. Within Electricity North West we have assigned 5 full time dedicated resources to the delivery of the C_2C Project and the Project will be managed by a full time Electricity North West Project manager. The team will also receive significant support from within the wider Electricity North West team. During this phase we will complete the technical development alongside GE and our demand response partners; this will include technical definition and the deployment and installation of the actuator and monitoring equipment. In parallel we will finalise the selection of the HV circuits for the Trial and seek the formal derogation against ER P2/6. Once software and hardware configuration and installation has been completed then Electricity North West is able to close open points on the selected HV circuits and begin the Trial.

The Commercial section will also focus on customer engagement, understanding customer attitudes towards demand response and designing appropriate commercial offerings. Throughout this section Electricity North West will focus on marketing the Trial and the C_2C Method to new connection customers whilst its demand response partners begin marketing to existing customers.

Finally the Learning & Dissemination section will incorporate all data analysis and knowledge dissemination activities including website development and build, conference attendance and the drafting of white papers. It's important to note that although these activities are defined in distinct sections they will often occur in parallel.

The approach detailed in the Project Plan is aligned with the analysis of the key technical, engineering, resource and Project management risks. The plan is designed to mitigate as far as possible the identified risks. Through considered discussion with consortium partners and suppliers, the available resources, technologies and equipment have been identified and costed and the Project Plan carefully matched to this.

Risks and Mitigation

Embedded within our Project management methodology is the capability to manage risks and issues; for this we have adopted the successful processes currently in operation within Electricity North West. The Risk and Issues Model employed considers risks and issues that are business-as-normal and those specifically related to the C_2C Project all of which will be articulated in a common format. Appendix 2 outlines the risks that have been identified prior to the start of the C_2C Project.

Within the risks model, likelihood and consequences will each be given a score from 1 to 5, and the resulting product of these two ratings used to score and rank the risks on the C_2C Project. The model has been used and refined for many years and has been found to be both robust and recognised as an exemplar approach. The format and description of the Electricity North West scoring matrix is presented in Appendix 2. The scoring matrix will be used by the PMO and Project Steering Committee to continually review Project risks, their mitigating action(s) and controls, and to ensure that risks are managed in priority order. The risk model describes the Methodology for determining an `uncontrolled' risk score. However, if control measures are applied, aimed at reducing the hazard and/or mitigating the risk, it should be possible to produce a `controlled' risk score that is lower than the `uncontrolled' risk. Also in place is a risk escalation process which documents how certain risk types are escalated up through the Project team.

The governance processes, to be operated across the Project Partners, will regularly review risks and issues and either remove these if agreed mitigation has occurred and/or bring new issues or risks to the attention of the Project Steering Committee. The Committee will agree management actions, which may lead to the Project being halted until such time as sufficient mitigation has occurred to enable on-going management of the risk or issue, or to halt the Project and defer further commitment until agreement has been reached with Ofgem on how to proceed.

Mitigation and contingency management will form a key part of the risk strategy. When a risk is raised the Project team will be responsible for creating a mitigation action that can be brought into play should the risk be realised. Embedded within the consortium agreement (see Appendix 12) are the appropriate contingency plans against each of the partners' responsibilities and deliverables.

6: Project readiness contd.

Existing Infrastructure
During the Quality of Supply program Electricity North West invested to develop functionality that allowed us to manage the network automatically; this functionality will be leveraged to the benefit of the C_2C Project and will allow us to build upon what currently exists in the ground. This mitigates any potential risk of delayswith technical delivery and enables the C_2C Project to start quickly and effectively once the C_2C Project has been awarded funding.

Customer Engagement
Throughout the bid preparation process Electricity North West has also worked to engage a number of potential customer groups to gauge support for and understanding of the C_2C Project. These efforts have included the following:

- *Internal Support:* The C_2C Project has received support from the Electricity North West Board and senior executives. The C_2C Project has also been profiled in the first issue of the new company magazine.
- *Corridor Manchester*: a number of customer meetings have been held early in 2011 to discuss various options of less capital intensive connections and the way in which the C_2C Method could help avoid significant reinforcement costs. These discussions have provided an early and positive indication of the appetite amongst a sample of large customers representative of the Electricity North West customer base.
- *MPs meeting* in June: Electricity North West senior executives met local MPs in which the concept of the C_2C Project was highlighted and a discussion developed on what the C_2C Method could mean for the industry.
- *Local Planning Authority Survey*: Electricity North West engaged PPS Group, a communications company, to do the following:
  - Identify development areas of the North West that would be appropriate for inclusion within the C_2C Project. These would be areas where development of commercial and industrial premises would be particularly likely, such as enterprise zones and land use allocations under the local development frameworks, alongside other areas of land where a developer is obviously seeking to bring forward the land for development; and
  - Obtain endorsement of and support for the C_2C Project at an in-principle level from key stakeholders, notably the local authorities. This support would take the form of a letter from the chief executive or other senior decision-maker.
- *EnerNOC Contract*: EnerNOC and Electricity North West signed a contract in May 2011 for the provision of a defined level of demand response capacity to Electricity North West. The agreement is for five years and will promote efficient electricity use within Electricity North West's service territory and enable regional businesses and organisations to be paid to reduce their energy usage when capacity is needed to support the distribution network. EnerNOC has been actively developing a customer base in the Electricity North West territory with a dedicated business development team.
- *EnerNOC Use Case*: EnerNOC has signed up one of its first UK DR customers in the Electricity North West territory; the Salford Royal NHS Foundation Trust in May 2011.
- *npower area assessment*; Electricity North West and npower have looked at npower's local I&C customer base together and have mapped out and ranked a set of target customers for the C_2C Project.
- *Association of Greater Manchester Authorities (AGMA):* AGMA has written supporting the C_2C Project.

6: Project readiness contd.

Circuit Selection
PB have conducted a first identification of the selected all the circuits that will be tested within the trial. This can be seen in Appendix 1. In addition the results of the Local Authority Planning Survey undertaken by PPSGroup (see Appendix 8) will be used in the final selection in section 1 of the delivery of the C_2C Project.

Project Costs and direct benefits
The C_2C Project costs have been calculated using input from the Project Partners and a finance resource from ENW . Where applicable the resource costs have been broken down to a day rate and extrapolated out over the period of the C_2C Project using the RPI forecast that Ofgem defined. Hardware and software costs have been supplied directly from suppliers; GE has significant experience in the installation and deployment of their PowerOn™ Fusion module and is thus confident over the accuracy of the associated costs. Within the overall cost calculation we have added an additional 10% as contingency to militate against any potential changes to costs as the Project continues. Benefits and costs have been put through Electricity North West's internal investment appraisal process and approved by its investors.

The overall budget will be managed through the Finance workstream. They will be responsible for managing all costs and constructing and delivering the reporting requirements as part of the C_2C Project. Within this workstream Electricity North West will run a robust financial tracking and reporting system in line with its current internal policies and frameworks. As per the Ofgem requirements the Project finances will be held in a separate bank account and which will be able to:

- Show all transactions relating to (and only to) the C_2C Project;
- Be capable of supplying a real time statement (of transactions and current balance) at any time;
- Accrue expenditures when a payment is authorised (and subsequently reconciled with the actual bank account);
- Accrue payments from the moment the receipt is advised to the bank (and then subsequently reconciled with the actual bank account);
- Calculate a daily total; and
- Calculate interest on the daily total according to the rules applicable to the account within which the funds are actually held.

Electricity North West will engage with our auditors, Deloitte, to alert them of their potential responsibilities should we be awarded the funding.

We believed there are two keys areas of uncertainty that will be mitigated against to avoid significant cost overrun. These are:

1. Network hardware equipment and installation costs: At this stage we have a theoretical view of which circuits we will be installing equipment on. However, as we investigate this further it may be necessary to change some of the specific circuits selected and this could have an impact on costs.

2. Payments to customers: At this stage we have a very limited view of the number of customers that will engage in the trial and subsequently it was very difficult to estimate the level of demand side response payments that may have to be paid out.

Details of mitigation plans can be seen within the full risk register in Appendix 2.

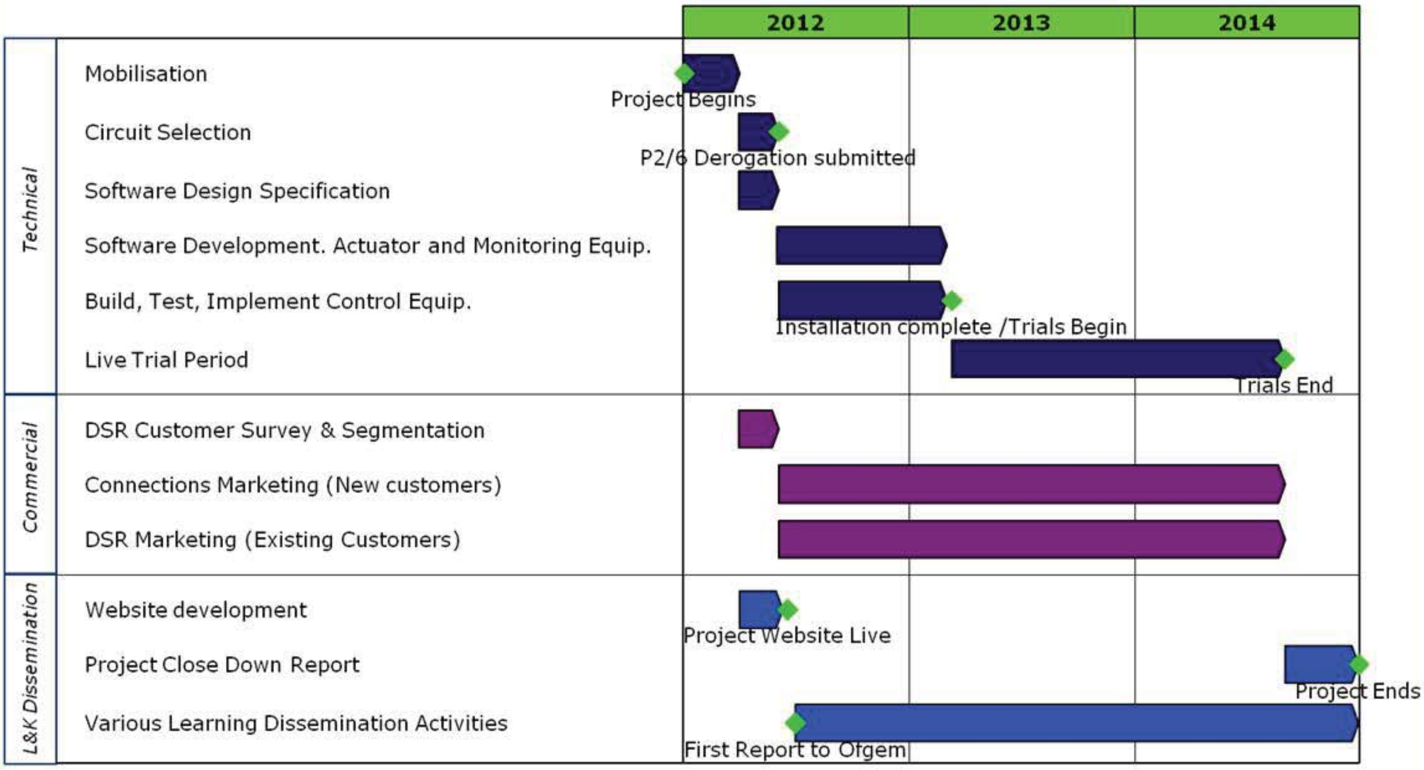
6: Project readiness contd.

6: Project readiness contd.

6: Project readiness contd.

6: Project readiness images

Figure 9 : C_2C High level project plan



Section 7: Regulatory issues

☒ Put a cross in the box if the Project may require any derogations, consents or changes to the regulatory arrangements.

Regulatory Impact
The C_2C Project could have profound implications on the design and operation of distribution networks and the involvement of customers in its operation. The potential longer term impact on the regulatory regime applied to network operators is significant with the following areas seeing change:

- regulatory regime for load related capital expenditure;
- regulatory allowance for purchase of new forms of Demand Side Response services;
- regulatory incentive mechanisms of Interruption Incentive Scheme (IIS), Losses and Distributed Generation,
- common connection and use of system charging methodologies applied by distribution network operators;
- regulatory regime for the provision of connections; and
- National Terms of Connection within Distribution Connection and Use of System Code (DCUSA).

The proposed shift in approach to the operation of the distribution network within the C_2C Project will impact the:

- potential non-compliance against ER P2/6; and
- regulatory incentive mechanisms of Interruption Incentive Scheme (IIS).

As a result we will be seeking a derogation from the Standard Licence Condition 24.1(a), and changes to the Quality of Supply (QoS) Regulatory Instruction and Guidance document

Engineering Recommendation P2/6 derogation
The C_2C Project will inherently increase the demand on HV circuits. In the event of an incident which causes interruption to supply demand side response services may be enacted to manage the demand on the HV circuits. Demand side response/ management is not a recognised technique under ER P2/6 and P2/6 does not allow for the use of latent capacity.

During the initial part of the C_2C Project, Electricity North West will make the final selection of HV circuits for the Trial, following engagement with stakeholders including development authorities. The selection and publication of the 180 HV closed rings and 20 HV circuits prior to the commencement of the Trial will be done to remove any perceived concerns of anti-competitive actions in the provision of connections.

A derogation from Standard Licence Condition 24.1(a) for the removal of the obligation to apply ER P2/6 for the defined Demand Group (ie the 180 HV closed rings and 20 HV circuits) in the Trial will be sought from Ofgem in the initial phase of the C_2C Project. The derogation will specify the designated Groups of Demand in the Trial and seek to exclude those HV circuits and the corresponding EHV circuits from ER P2/6 Table 1 for the duration of the C_2C Project. The draft derogation application can be seen in Appendix 5.

Proposed amended to reporting under Interruption Incentive Scheme
The use of delayed restoration or limited restoration techniques for customers on managed contracts within the Trial will incur CI and CML penalties under the Interruption Incentive Scheme. Electricity North West has drafted an amendment to the Quality of Supply (QoS) Regulatory Instruction and Guidance document which recognises the existence of customer's willing to enter into a managed contract that may result in the delayed restoration or partial restoration of supplies following an network event causing a supply interruption. The suggested amendments can be seen in Appendix 9 and propose a change to the Quality QoS Regulatory Instruction and Guidance document to exclude demand side and generation side response thereby excluding these interruptions to supply from Charge Restriction Condition 8. The Second Tier Funding Request includes a sum of £25,000 to fund the penalty assuming this amendment is not granted.

7: Regulatory issues contd.

Incentive Schemes

In the development of the business case for this C_2C Project Electricity North West has investigated the potential impact of the C_2C Project on the incentive schemes in place for distribution network operators, namely losses and IIS. This research has revealed that the time lag in the delivery of benefits for these incentive mechanisms means that the any benefits that may arise will not be known until up to 2 years after the C_2C Project has been completed and we have been advised by Ofgem to exclude from the C_2C Project.

7: Regulatory issues images, charts and tables

Regulatory issues images

Section 8: Customer impacts

Customers within C_2C Project
The scope of the C_2C Project will directly encompass approximately 360 HV circuits/ 180 closed HV rings and 20 HV circuits (ie 13% of the distribution network) and indirectly involved about 317 000 customers. The HV circuits identified (see Appendix 1 showing the geographic split of the circuits throughout Electricity North Wests territory) will contain the full range of customer types connected to Electricity North West's distribution network. Without the support of our customers for the Project and the active engagement of a small number of participating customers the C_2C Project will not succeed. Therefore the customer experience of the C_2C Project is paramount to its success.

Customers' Experiences
In preparation for this Full Submission Electricity North West has consulted with the planning and development departments of the North West local government bodies to gain feedback on the proposed C_2C Project and understand how we can work together with these stakeholders to drive mutual benefits for local communities. We will use the feedback gained to adapt the Circuit Selection Methodology (see Appendix 8 Local Government support for the C_2C Project).

Through the lifecycle of the C_2C Project we will as a consortium engage with our customers and stakeholders for a range of reasons.

General publicity: Electricity North West will publicise in the local media the C_2C Project as a successful Second Tier Low Carbon Networks Fund project and outline its scope and benefits to customers, stakeholders and Electricity North West.

Customer Survey: The consortium will conduct customer surveys to understand the type of customer who would be willing to consider demand and generation side provision and at what cost. This information will be used to segment customer in order to understand the potential scope and size of the demand and generation side response market.

Marketing: Electricity North West will advertise the C_2C Project to potential connection customers (and their agents) as a means of reducing the cost of connection. The HV circuits and associated EHV circuits in C_2C Project will be identified within the first six months following initiation of the C_2C Project and publicised (see Project Plan in Appendix 2). The selected circuits will also be identified in Schedule A of the ER P2/6 derogation application. The main reasons for widely publishing the selected circuits is to negate any risk of perceived anti-competitive behaviour in the provision of connections market.

Demand Side Response: Our demand side response partners: Flexitricity and npower and EnerNOC will engage industrial and commercial customers, with a Maximum Capacity of 100kW and above, connected to the named HV circuits in order to purchase demand and/ or generation side response for the C_2C Project.

New Connections: A small dedicated team within Electricity North West's Connections business will manage the customer contact for new connections wishing to be part of the C_2C Project. All new connection applications seeking a connection above 100kW, and which involves reinforcement, to the selected HV circuits, will receive a `traditional network solution' connection offer and information on the C_2C Project. (Appendix 6 shows the overall connection process). We have agreed with Ofgem to record and report our performance in creating and discussing the options with the customer as this information would assist with the development of a future standard.

Customer Feedback: Prior to customer engagement we will have defined an agreed approach to ensure consistency of the results and we will seek feedback from the customers at all stages. For example, in the connection process we will seek feedback from each connection application customer on the reasons for choosing their preferred connection approach, whether the traditional connection offer or the C_2C connection offer.

Planned Supply Interruptions: Customers will not experience supply interruptions for the installation of the remote control equipment, monitoring and measurement equipment nor the communications infrastructure. Electricity North West also will minimise planned supply interruptions for maintenance purposes during Trial period.

8: Customer impacts contd.

Unplanned Supply Interruptions: The change in operating arrangements for the selected circuits within the C_2C Project could potentially increase the number of short duration interruptions experienced by all customers ie. the closing of the NOP to form a closed ring will generally mean double the number of customers will experience an individual fault event. But the new operating regime should deliver a shorter interruption to supply, than under the current operating arrangements. It is worth highlighting that the likelihood of a customer experiencing an interruption of any length is very low due to the selection of the circuits within the C_2C Project. Unplanned supply interruptions during the C_2C Project will allow us to prove the concept works and that the control management systems operates as expected and contracted customers provide the demand side or generation side response as required.

Managing Customer Enquiries

C_2C *Project website:* Information on the C_2C project will be available on a section of Electricity North West's website (www.enwl.co.uk/capacitytocustomers) providing details of the project, FAQs and contact details.

Enquiries: Customers can ask questions or raise queries related to the C_2C Project using the following channels:

1. **Telephone:** Electricity North West operates an enquiry service that is continuously staffed and can be contacted 24 hours a day on 0800 1954141. There will be a specific Interactive Voice Response (IVR) option available for Low Carbon Networks Fund enquiries.

2. **Written correspondence:** The C_2C Project Team will handle written general enquiries from customers and stakeholders.

   Post

   Customer can contact the project team by post at the following address:

   C_2C Project Team

   304 Bridgewater Place

   Birchwood Park

   Warrington

   WA3 6XG

   Email

   Customers can contact the project team at the following email address: futurenetworks@enwl.co.uk for any queries.

Customer Engagement Plan

Electricity North West has drafted a Customer Engagement Plan which describes how it will engage with the wider community to publicise the C_2C Project; engage with every customer impacted by the C_2C Project; and have special regard to Priority Service Register (PSR) customers directly or indirectly involved in the C_2C Project.

This Plan details how Electricity North West and its Project Partners, will engage, or affect, customers during the C_2C Project. It also provides general information about the C_2C Project and how to take part in one of the trials; or to gain their consent to install remote controlled and/or monitoring equipment at their premises; and to respond to individual customer queries or complaints.

The Customer Engagement Plan for the C_2C Project is contained within Appendix 6.

8: Customer impacts contd.

8: Customer impacts contd.

8: Customer impacts images, charts and tables

Customer Impacts images

Section 9: Succesful Delivery Reward Criteria

Criterion (9.1)

HV Circuit Selection

1. Finalise HV circuit selection to identify HV circuits for the Trial.
2. Develop HV circuit variation methodology (recognising HV circuits may need to be varied in the Trial and to mitigate the perceived risk of anti-competitive behaviour).
3. Publicise HV circuits selected to be included in the C_2C Trial and publish methodologies for HV circuit selection and variation.

Engineering Recommendation P2/6 Derogation Application

1. Revise Engineering Recommendation P2/6 derogation, taking into consideration comments from Ofgem consultation, and include selected HV circuits in derogation application's Appendix.
2. Apply for Engineering Recommendation P2/6 derogation for the C_2C Project from Ofgem.

Evidence (9.1)

HV Circuit Selection

1. In June 2012, publish the HV circuits included within the C_2C Trial, the HV Circuit Selection Methodology and the HV Circuit Variation Methodology on the C_2C Project's website.
2. In October 2012, publish information pamphlet on the HV circuits selected for Trial.

Engineering Recommendation P2/6 Derogation Application

1. In June 2012, submit derogation application to Ofgem.

Criterion (9.2)

Demand response customer segmentation methodology

1. Update and enrich customer data for I&C customers on selected HV circuits.

2. Undertake customer survey of I&C customers on selected HV circuits.

3. Create customer segmentation model.

Evidence (9.2)

Demand response customer segmentation methodology

1. Customer data updated in April 2012.

2. Customer survey completed in June 2012.

3. Demand response customer segmentation model completed and published on C_2C Project's website in July 2012.

9: Succesful delivery reward criteria contd.

Criterion (9.3)

Customer Engagement

1. Finalise Customer Engagement Plan to Ofgem.
2. Develop C_2C Project's website.
3. Finalise and publicise the C_2C Connection Offer process.
4. Develop new C_2C commercial templates for new connections and existing customers.
5. Produce customer marketing/ campaign materials and magazine advertisements.
6. Generate customer e-mail database and e-mail customers directly.
7. Deliver customer seminars and workshops.

Evidence (9.3)

Customer Engagement

1. Customer Engagement Plan approved by Ofgem in June 2012 and C_2C Project's website live in June 2012.
2. Trial HV circuits published in June 2012.
3. C_2C Connection Offer process published in September 2012.
4. First trade magazine article published in September 2012.
5. First pamphlets distributed in October 2012, with subsequent pamphlets delivered as per Project Plan.
6. New C_2C commercial templates for new connections and existing customers available for issue to customers by December 2012.
7. First customer seminar/ workshop delivered in December 2012, with subsequent seminars/ workshop delivered as per Project Plan.
8. Various engagement programs continued through until Dec 2014, using various channels including website and e-mail.

Criterion (9.4)

Technology Implementation and Project `go live'

1. All software designed, tested, built and implemented.
2. All hardware including remotely controlled actuators, network monitoring equipment and communications infrastructure installed on the network.
3. Testing to prove capability of network management system to monitor and manage network events (thereby releasing network capacity and allowing customers to engage in managed contracts for new connections and new demand response contracts).

Evidence (9.4)

Technology Implementation

1. Software design completed by April 2012.
2. Software and IT hardware installation, testing and commissioning completed by March 2013.
3. Actuators, communication and monitoring equipment installed, tested and commissioned by March 2013.

Project 'go-live'

1. Live trials commence April 2013.
2. Demand response capability test completed for all contracted C_2C customers by December 2014.

9: Succesful delivery reward criteria contd.

Criterion (9.5)

Development, consultation and submission of ER P2/6 change proposals

1. Develop a set of recommendations for potential changes to Engineering Recommendation P2/6.

Evidence (9.5)

Development, consultation and submission of ER P2/6 change proposals

1. Complete simulation exercises to inform discussions by April 2013.
2. Hold workshops between April 2013 and July 2013 to inform proposals.
3. Issue industry consultation between September 2013 and December 2013.
4. Issue recommendations report in September 2014.

Criterion (9.6)

Dissemination of knowledge

1. Database established for collection and dissemination of network data to academic institutions.
2. Dissemination milestones met throughout the course of the C_2C Project including quarterly publications, periodic reports to Ofgem and regular Project website updates.
3. Identification of suitable industry conferences to attend.
4. Drafting of white papers for industry journals and magazines.
5. Production of final C_2C Project close down report.

Evidence (9.6)

Dissemination of knowledge

1. Network data made available to stakeholders throughout C_2C Project and available for at least 18 months after Project close down.
2. Six-monthly progress reports submitted to Ofgem/ industry throughout C_2C Project.
3. Five industry conferences attended and presented at by December 2014.
4. LCN Fund Annual Conference attended and presented at by December 2014.
5. Published (or had accepted for publication) six white papers for magazines or journals for industry or academic audiences, as per Project Plan, throughout C_2C Project.
6. Close down report submitted to Ofgem in December 2014.

9: Succesful delivery reward criteria contd.

Criterion (9.7)

Demand Response Contracts

1. Enter into a number of new commercial arrangements for the provision of a demand and/ or generation response, including both:
   i) New C_2C managed connection agreements; and
   ii) New C_2C managed demand and/ or generation response contracts.

Evidence (9.7)

Demand Response Contracts

1. New managed contracts entered into with demand and/ or generation customers or their agents, including:
   i) At least ten C_2C managed connection agreements by September 2014; and
   ii) At least ten C_2C managed contracts for demand and/ or generation response with existing customers, either directly and/ or via an agent by September 2014.

Criterion (9.8)

Evidence (9.8)

Section10: List of Appendices

1. Maps and network diagrams

2. Project plan, risk register, mitigation plan and organogram

3. Project Partner details

4. Ofgem excel workbook

5. Derogation and exemptions

6. Customer engagement plan

7. PB case study description

8. PPS Survey Results

9. Change proposal for amending QoS

10. Circuit selection methodology

11. Carbon saving methodology

12. Consortium agreement

13. C_2C event sequence

List of Changes

This section documents the changes from the original Full Submission version, submitted on 17 August 2011, to this version.

The table below details each change and the reason for the change. The changes are collated into the two sections of the evaluation phase for the C_2C Project, namely the Questions and Answers Process and the Expert Panel / Consultants' Review.

The first half of the table below details the changes to the document resulting from the answers provided during the Questions and Answers Process of the evaluation phase. Most of these changes are either correcting errors in the document or providing clarification in the document.

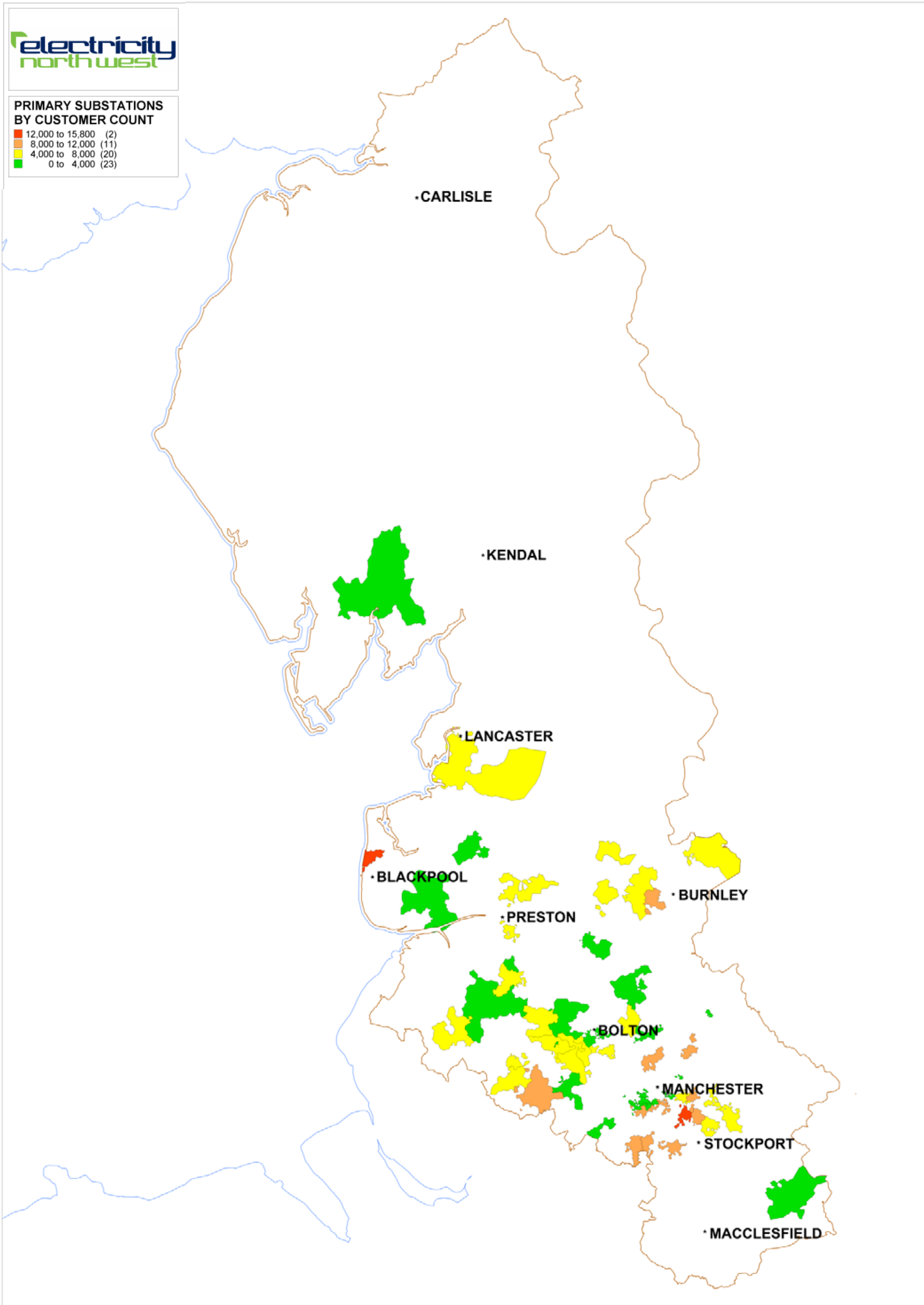
The second half of the table details the changes to the document following the feedback from the Expert Panel and the Consultants' Report. The changes made derive from the feedback on the low number of faults experienced in the Trial. To address this concern Electricity North West has included a further 20 HV circuits (from the higher fault rate HV circuits) to increase the number of faults in the Trial period and to test the customer acceptability for managed contracts across the range of circuit fault rates. These additional HV circuits will be operated radially to limit the interruptions to adjacent circuits. This requires only a margin change to the project costs thereby increasing the C_2C Project's value for money, as the higher fault rate circuits already have distribution remote control equipment fitted.

All changes to the Full Submission and Appendices documents are easily identifiable as they coloured red. The exceptions to this rule are 1) the opening sentence in Full Submission Sections 2, 3, 4 , 5 & 6 are highlighted in red to emphasise the key messages in that section and 2) the draft words for the change to the Quality of Supply Regulatory Instructions and Guidance document in Appendix 9 are highlighted in red.

Questions and Answer Process			
Location	**Change**	**Reason**	**Generated**
Section 3, page 17	Table which shows the C_2C Project's costs broken down by year for the cost categories shown in the Section 3, page 13 of the Full Submission.	Clarification	Q28
Section 4, page 22	Change 180 to 1 800.	Correct an error	Q12
Section 4, page 22	Change £20.8M to £29.6M.	Correct an error	Q11
Section 9, pages 49 to 52	Revised Success Delivery Reward Criteria.	Clarification	Q33
Appendix 2, page 4	The Mitigation column heading in the Risks table was poorly defined as the shown mitigation actions are examples of actions that could be applied.	Clarification	Q26
Appendix 4, 'Net Benefits tab', cell C19	Correct summation – changes £20.8M to £29.6M.	Correct an error	Q11

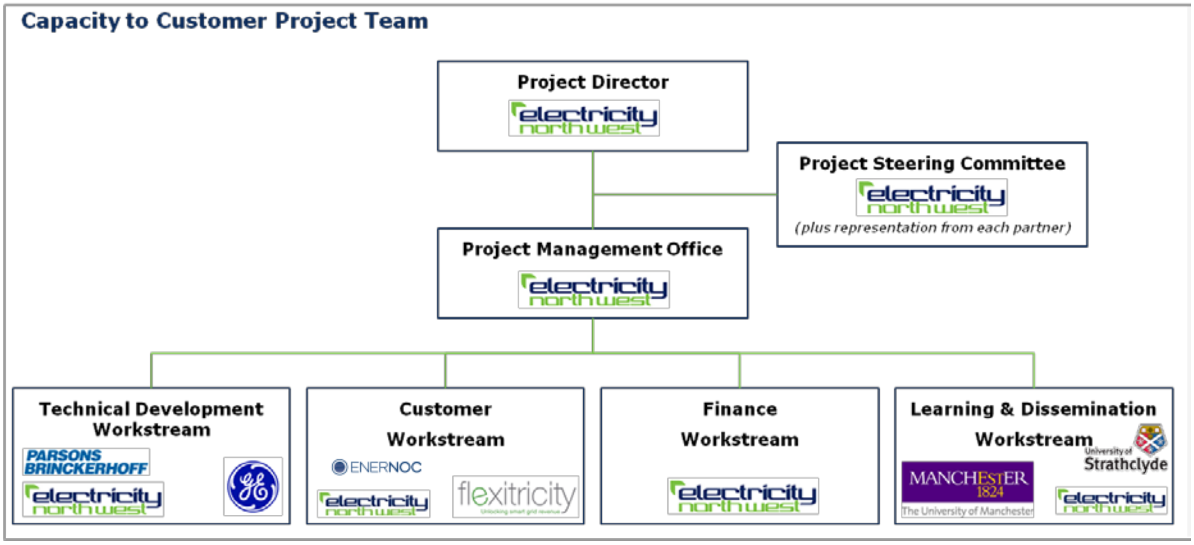
Expert Panel / Consultants' Report			
Location	**Change**	**Reason**	**Generated**
Section 1.4, page 1	Updated Second Tier Funding request.	Value for money	Expert Panel
Section 2, page 3	• Add 20 HV circuits after '180 HV rings' • Change 12% to 13% • Change 300 000 to 317 000 (customers) • Sentence inserted detailing change of project scope from including an extra 20 HV circuits from the Red (high fault rate range) in the trial to test customers' acceptability for managed contracts across the spectrum of circuit fault rates.	Value for money	Expert Panel
Section 2, pages 7	• Change 1 200 to 1 270 (I&C customers) • Change in expected number of faults experienced in Trial • Change in number of new connections in Trial.	Value for money	Expert Panel
Section 2, pages 8	• Add 'and 20 HV circuits' after '180 HV rings' • Change 1 200 to 1 270 (I&C customers)	Value for money	Expert Panel
Section 2, page 9	• Change 12% to 13% • Change 1 200 to 1 270 (I&C customers)	Value for money	Expert Panel
Section 3, page 13	Updated costs.	Value for money	Expert Panel
Section 3, page 14	Updated number of projects connected with C_2C terms and conditions and updated Direct Benefits.	Value for money	Expert Panel
Section 3, page 17	Revised Project Costs Segments and Funding Breakdown charts	Value for money	Expert Panel
Section 7, page 41	Add 'and 20 HV circuits' after '180 HV closed rings'	Value for money	Expert Panel
Section 8, page 44	• Add 'and 20 HV circuits' after '180 HV closed rings' • Change 12% to 13% • Change 300 000 to 317 000.	Value for money	Expert Panel
Section 9, pages 52	Revised Success Delivery Reward Criteria: Increased signed managed contracts.	Value for money	Expert Panel

Appendix 1: Map of C_2C Circuit Locations across ENWL Territory



Appendix 2: Programme Governance, Risks, Mitigation and Project Plan

Programme Governance



Risk Register

The Risk Model employed by Electricity North West looks at risks that are not simply business-as-normal issues, nor related to a Project, but are articulated in a common format, viz:

"There is a risk that undesirable will happen, leading to consequences, because of trigger or compounding factors."

In the Electricity North West model, likelihood and consequences are given a score from 1 to 5, and the resulting product of these two ratings used to score and rank the risks on the business. The model has been used for many years and has been found to both be robust and recognized as an exemplar approach3. The format of the Electricity North West scoring matrix is presented in below.

Likelihood

Rating	Descriptor	Description	% Chance of Happening	Regularity of Risk Once in:
1	Rare	Very low chance	<5%	Above 10 years
2	Low	Low chance	<10%	10 years
3	Moderate	Medium chance	<25%	5 years
4	Likely	Fairly likely	<50%	1 year
5	Almost Certain	More than likely	>50%	A quarter year

Reputation Impact

Level	Description	Descriptor
1	Insignificant	Negligible
2	Local press article – low running order eg Electricity North West or ASP action criticised from partner forums, local pressure groups, alleged "expert" etc.	Minor
3	Criticism in Industry Press or local press – front page. Electricity North West or ASP proposals/outcomes receive negative reaction in the electricity forums, and/or from Regulator(s).	Moderate
4	Local TV/Tabloid Press – low running order. Electricity North West brand raised into prominence (eg incident, business performance) and publicised negatively by Regulator and electricity pressure groups. Minor effect on or prominence for owning consortia.	Significant
5	National Media Coverage – TV and newspapers. Failure to adequately address known problem or to anticipate or prepare for unpredictable occurrence. Electricity North West and owning consortia heavily criticized in media.	Serious

Financial Impact

Rating	Financial Impact
1	<£10k
2	£10k - £100k
3	£100k - £1M
4	£1M - £10M
5	>£10M

Health, Safety and Environment Impact

Level	Health	Safety	Environment	Descriptor
1	Short term work related sickness absence exceeds departmental target	Minor accident/ Near Miss	EA unaware & Electricity North West sees no need for reporting	Negligible
2	Long term sickness exceeds departmental target. Involvement of company doctor.	Lost time injury. HSE request for information after accident.	EA request information. eg oil leak, diesel spillage.	Minor
3	Major injury or occupational risk exposure e.g. contact with hazardous substance HSE Letter of Concern.	Major accident e.g. RIDDOR reportable. HSE Letter of Concern.	Major environmental incident eg contamination of water course. EA letter of concern.	Moderate
4	Occupationally contracted disease eg HAV's >5% of employees involved in specific activity/HSE Enforcement notice or Prohibition Notice.	Major accident resulting in up to 5 Fatalities / Possible HSE Enforcement or Prohibition Notice.	Major risk or environmental issue leading to EA or other regulatory body serving Prohibition Notice.	Significant
5	Occupationally contracted disease eg HAV's >10% of employees involved in specific activity/ HSE Enforcement Notice or Prohibition Notice.	Major accident resulting in > 5 fatalities and / or widespread damage beyond site boundaries Possible HSE Prohibition notice.	Fundamental break-down in working relationship with EA or other regulator	Serious

Security of Supply Impact

Level	Description	Descriptor
1	Small numbers of customers affected. Concluded within 18 hours.	Negligible
2	Small numbers of customers affected after 18 hrs.	Minor
3	Moderate numbers of customers affected. Restoration of supplies outside Standards of Service.	Moderate
4	Large numbers of customers affected. Restoration of large numbers of supplies outside Standards of Service.	Significant
5	Large numbers of customers affected. Widespread service failure.	Serious

The scoring matrix is used by Electricity North West's Board and senior management to continually review business risks, their mitigating action(s) and controls, and to ensure that risks are managed in priority order.
The risk model presented here describes the methodology for determining an 'uncontrolled' risk score. However, if control measures are applied, aimed at reducing the hazard / mitigating the risk, it should be possible to produce a 'controlled' risk score that is lower than the 'uncontrolled' risk. The selection and application of control measures can be influenced by a number of factors, eg:

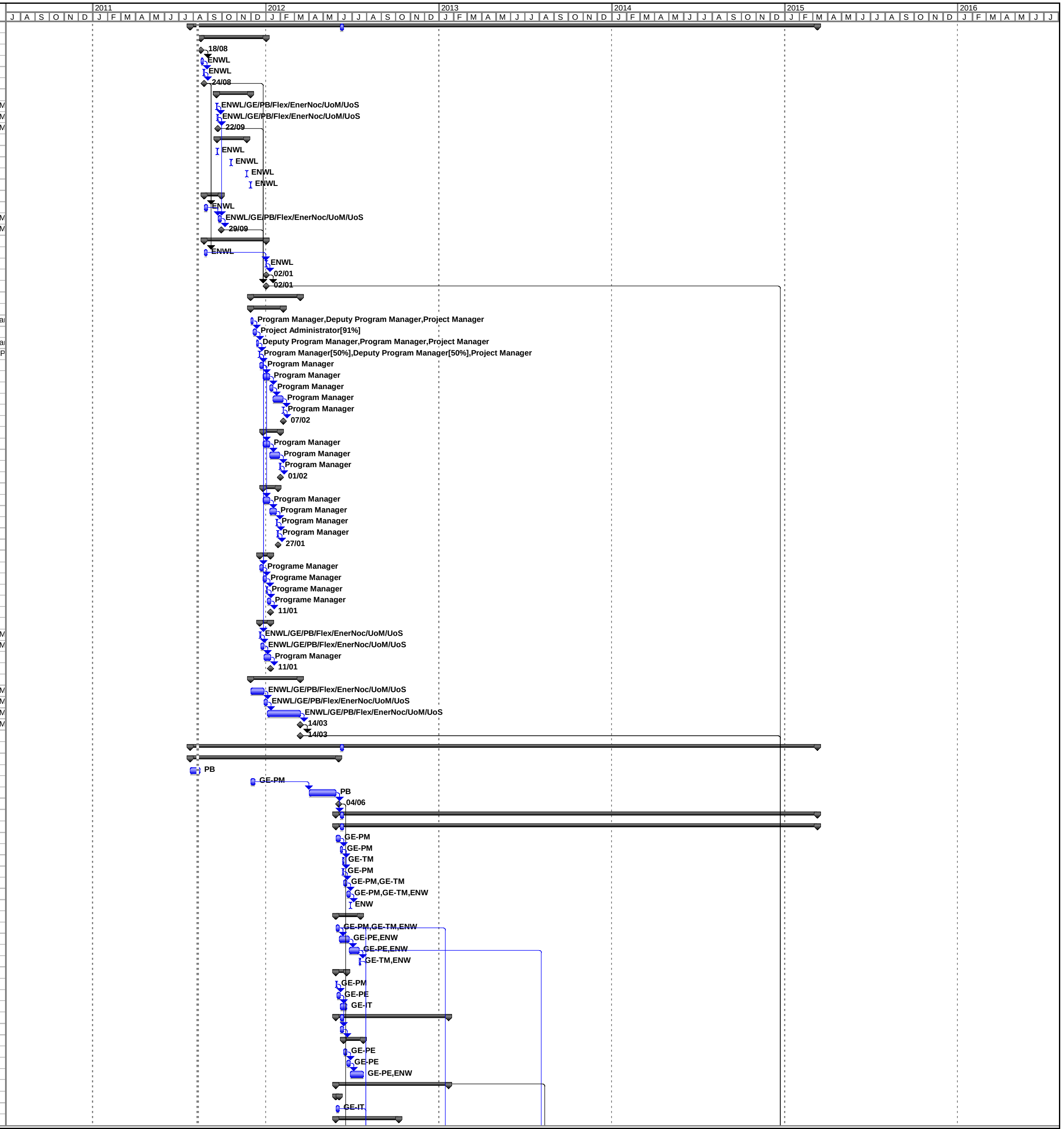
- Severity of the hazard;
- Magnitude of the risk;
- Consequences of an undesirable event occurring;
- Constraints on the use of control measures, eg: cost, practicality, resource.

Throughout the bid preparation process the following potential project risks have been identified. They have been scored based on the scoring matrix set out above and some example mitigation actions have also been documented.

No.	Description	Likelihood*	Impact Rating*	Impact Area	Mitigation	Risk Rating***
1	Risk that internal Operations team will not be able to support installation of automation devices	3	4	Project	• Proposal for ring fenced team within connections teams • Seek additional support from PB Power when appropriate	12
2	There is a risk that the key personnel will not be avaliable to deliver the project	3	4	Project	• Ensure that key individuals share knowledge they have with others and document any specific information to ensure effective knowledge transfer	12
3	There is a risk of problems with the financial control of the project because of the new requirement for and management of separate bank accounts. This will require all new processes for management of procurement, suppliers, payment control and cashflow across the project partners leading to possible impacts in all these areas..	3	4	Financial	• Develop effective financial controls in conjunction with Electricity North West finance directorate. Ensure robust and regular audit regime.	12
4	There is a risk that the project fails to achieve its predicted Low Carbon Saving because of inaccurate estimates or significant change. This could lead to loss of reward, loss of reputation and environmental impacts.	3	4	Project / Environmental / Reputation	• Monitoring of carbon impacts to be ongoing to ensure early identification of issues.	12
5	There is a risk that poor project management causes cost overruns leading to loss of reputation, damage to project and loss of any successful delivery reward.	2	5	Project / Financial / Reputation	• Ensure appropriately skilled PM resources are appointed into the project. • Governance and risk regime should ensure issues picked up early.	10
6	Network hardware equipment and installation cost estimates will overrun	3	3	Financial	• Work with PB to deliver most accurate circuit selection document • Raise any cost implications to finance workstream as early as possible • Potentially use sidelined contingency	9
7	DSM payments to customers estimates will overrun	3	3	Financial	• Raise any cost implications to finance workstream as early as possible • Potentially use sidelined contingency	9
8	Risk that project partners walk away once the project is won and ready for kick off.	2	4	Project	• Ensure robust consortium agreement in place to outline mitigation should such a situation arise • Identify secondary partners who could be called upon if risk materialised.	8

The Project Plan can be seen on the following pages.

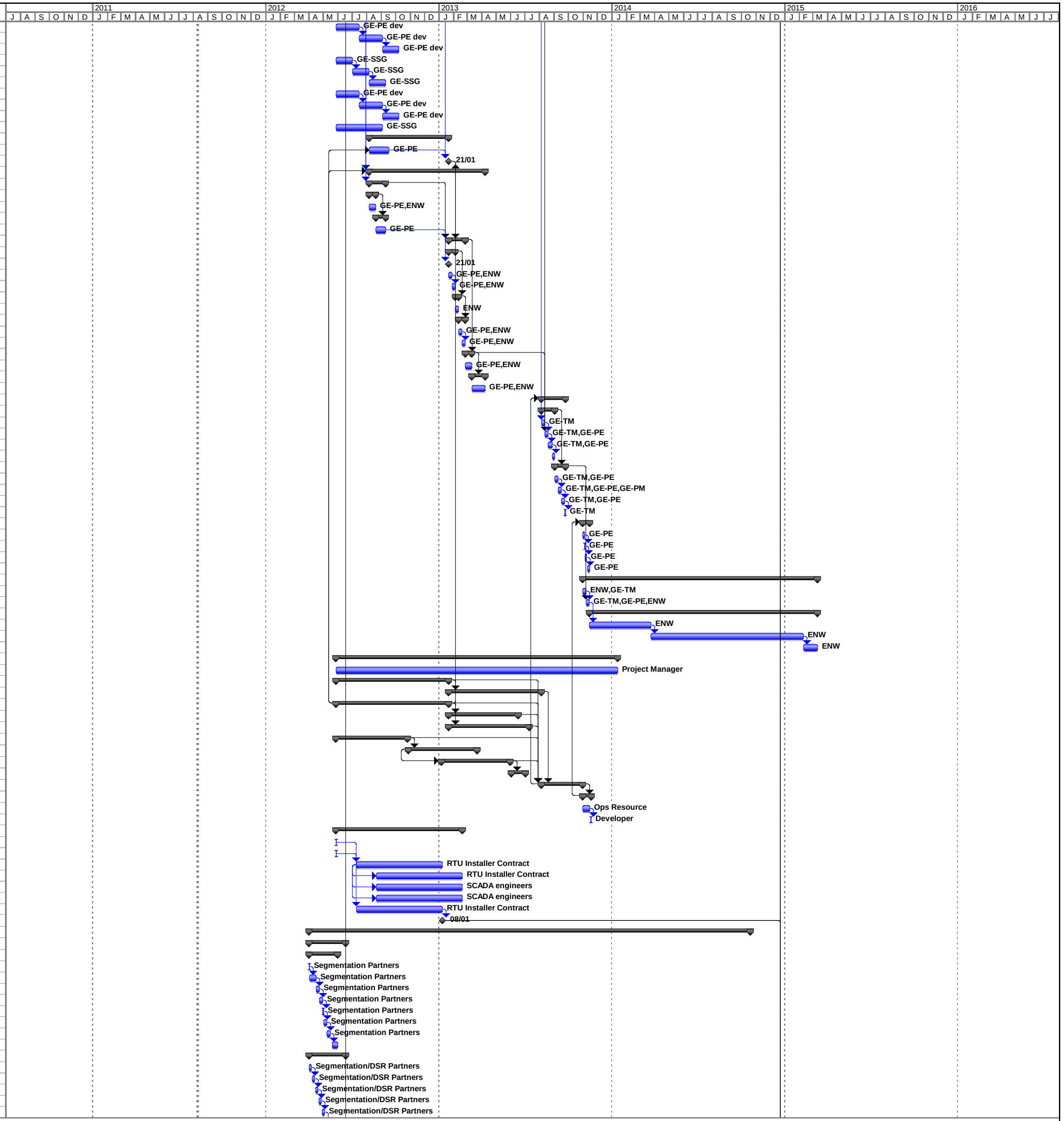
ID	Task Name	Duration	Start	Finish	Predeces	Resource Names
1	**Capacity to Customer Project**	**947 days?**	**Tue 26/07/11**	**Wed 11/03/15**		
2	**Phase 0 - Activities Pre-Award**	**98 days?**	**Thu 18/08/11**	**Mon 02/01/12**		
3	Full Submission issued to Ofgem	0 days	Thu 18/08/11	Thu 18/08/11		ENWL
4	Identify activities to complete prior to award	3 days	Thu 18/08/11	Mon 22/08/11	3	ENWL
5	Create outline plan for presentation to Steering Group	2 days	Tue 23/08/11	Wed 24/08/11	4	ENWL
6	Presentation to Steering Group	0 days	Wed 24/08/11	Wed 24/08/11	5	ENWL
7	**External Collaborators**	**52 days?**	**Tue 20/09/11**	**Wed 30/11/11**		
8	Hold workshop with all collaborators	1 day	Tue 20/09/11	Tue 20/09/11		ENWL/GE/PB/Flex/EnerNoc/UoM
9	Agree next steps/actions	2 days	Wed 21/09/11	Thu 22/09/11	8	ENWL/GE/PB/Flex/EnerNoc/UoM
10	Confirm on-going communications	0 days	Thu 22/09/11	Thu 22/09/11	9	ENWL/GE/PB/Flex/EnerNoc/UoM
11	**Regular review meetings**	**45 days**	**Wed 21/09/11**	**Tue 22/11/11**		
12	Regular review meetings 1	1 day	Wed 21/09/11	Wed 21/09/11		ENWL
13	Regular review meetings 2	1 day	Thu 20/10/11	Thu 20/10/11		ENWL
14	Regular review meetings 3	1 day	Tue 22/11/11	Tue 22/11/11		ENWL
15	Adward decision	1 day?	Wed 30/11/11	Wed 30/11/11		ENWL
16	**Resources**	**26 days**	**Thu 25/08/11**	**Thu 29/09/11**		
17	Identify ENW resource requirements for installation/commissioning activities	5 days	Thu 25/08/11	Wed 31/08/11	6	ENWL
18	Identify External Collaborator resources to support installation/commissionin	5 days	Fri 23/09/11	Thu 29/09/11	17,9	ENWL/GE/PB/Flex/EnerNoc/UoM
19	Resource plan estbalished and agreed	0 days	Thu 29/09/11	Thu 29/09/11	18	ENWL/GE/PB/Flex/EnerNoc/UoM
20	**Financial**	**93 days?**	**Thu 25/08/11**	**Mon 02/01/12**		
21	identfy and implement project budget controls within ENW	4 days	Thu 25/08/11	Tue 30/08/11	6	ENWL
22	Set up project bank account	1 day?	Mon 02/01/12	Mon 02/01/12	21	ENWL
23	Financial controls established	0 days	Mon 02/01/12	Mon 02/01/12	22	ENWL
24	**Phase 0 Complete**	0 days	Mon 02/01/12	Mon 02/01/12	23,6,10,1	
25	**Phase 1 - Project Set-Up**	**75 days**	**Thu 01/12/11**	**Wed 14/03/12**		
26	**Program Management office Start-up**	**49 days**	**Thu 01/12/11**	**Tue 07/02/12**		
27	Develop Implementation Plan and Schedule	3 days	Thu 01/12/11	Mon 05/12/11		Program Manager,Deputy Progra
28	Develop project administration services	5 days	Tue 06/12/11	Mon 12/12/11	27	Project Administrator[91%]
29	Identify Key Implementation Team, Roles and Contacts	4 days	Tue 13/12/11	Fri 16/12/11	28	Deputy Program Manager,Progra
30	Programme Kick-off Meeting	1 day	Mon 19/12/11	Mon 19/12/11	29	Program Manager[50%],Deputy P
31	Review Programme Roles and Responsibilities	5 days	Tue 20/12/11	Mon 26/12/11	30	Program Manager
32	Confirm and Agree Governance Board Membership	10 days	Tue 27/12/11	Mon 09/01/12	31	Program Manager
33	Identify reporting requirements	5 days	Tue 10/01/12	Mon 16/01/12	32	Program Manager
34	Develop reporting and procedures	15 days	Tue 17/01/12	Mon 06/02/12	33	Program Manager
35	Set up executive review meetings	1 day	Tue 07/02/12	Tue 07/02/12	34	Program Manager
36	Programme Management Office established	0 days	Tue 07/02/12	Tue 07/02/12	35	Program Manager
37	**Change Management**	**27 days**	**Tue 27/12/11**	**Wed 01/02/12**		
38	Design CM proceses	10 days	Tue 27/12/11	Mon 09/01/12	31	Program Manager
39	Develop procedures	15 days	Tue 10/01/12	Mon 30/01/12	38	Program Manager
40	Sign-off processes and procedures	2 days	Tue 31/01/12	Wed 01/02/12	39	Program Manager
41	Change Management implemented	0 days	Wed 01/02/12	Wed 01/02/12	40	
42	**Quality Assurance & Audit**	**24 days**	**Tue 27/12/11**	**Fri 27/01/12**		
43	Define review procedures	10 days	Tue 27/12/11	Mon 09/01/12	31	Program Manager
44	Define monitoring & control procedures	10 days	Tue 10/01/12	Mon 23/01/12	43	Program Manager
45	Schedule regular QA audits	2 days	Tue 24/01/12	Wed 25/01/12	44	Program Manager
46	Schedule finacial review audits	2 days	Thu 26/01/12	Fri 27/01/12	45	Program Manager
47	QA established	0 days	Fri 27/01/12	Fri 27/01/12	46	ENWL
48	**Communications**	**17 days**	**Tue 20/12/11**	**Wed 11/01/12**		
49	Develop Communication Plan	5 days	Tue 20/12/11	Mon 26/12/11	30	Programe Manager
50	External Collaborators programme launch	5 days	Tue 27/12/11	Mon 02/01/12	49	Programe Manager
51	Partners programme launch	2 days	Tue 03/01/12	Wed 04/01/12	50	Programe Manager
52	Implement communications plan	5 days	Thu 05/01/12	Wed 11/01/12	51	Programe Manager
53	Communications plan in place	0 days	Wed 11/01/12	Wed 11/01/12	52	
54	**Learning Capture and Dissemintation**	**17 days**	**Tue 20/12/11**	**Wed 11/01/12**		
55	External partners workshop	2 days	Tue 20/12/11	Wed 21/12/11	30	ENWL/GE/PB/Flex/EnerNoc/UoM
56	Agrre processes for learning capture	5 days	Thu 22/12/11	Wed 28/12/11	55	ENWL/GE/PB/Flex/EnerNoc/UoM
57	Develop procedures for collaborators	10 days	Thu 29/12/11	Wed 11/01/12	56	Program Manager
58	Implement learning capture processes	0 days	Wed 11/01/12	Wed 11/01/12	57	L&D lead
59	**Commercial Arrangements**	**75 days**	**Thu 01/12/11**	**Wed 14/03/12**		
60	Complete commercial arrangements with all external partners	20 days	Thu 01/12/11	Wed 28/12/11		ENWL/GE/PB/Flex/EnerNoc/UoM
61	Define requirements with vendor suppliers	5 days	Thu 29/12/11	Wed 04/01/12	60	ENWL/GE/PB/Flex/EnerNoc/UoM
62	Agree commercial arrangements and call-off schedules with all product supp	50 days	Thu 05/01/12	Wed 14/03/12	61	ENWL/GE/PB/Flex/EnerNoc/UoM
63	Completion of major supply / vendor agreements	0 days	Wed 14/03/12	Wed 14/03/12	62	ENWL/GE/PB/Flex/EnerNoc/UoM
64	**Phase 1 - Project Office Set complete**	0 days	Wed 14/03/12	Wed 14/03/12	63	
65	**Phase 2 - Technical Development**	**947 days?**	**Tue 26/07/11**	**Wed 11/03/15**		
66	**Circuit Identification**	**224 days**	**Tue 26/07/11**	**Mon 04/06/12**		
67	first draft of circuit selection methodology	15 days	Tue 26/07/11	Mon 15/08/11		PB
68	Methodology refined and second draft completed	7 days	Thu 01/12/11	Fri 09/12/11		GE-PM
69	Methodololgy applied to ENWL network	41 days	Mon 02/04/12	Mon 28/05/12	68	PB
70	Final list of circuits identified	0 days	Mon 04/06/12	Mon 04/06/12	69	PB
71	**Industrialisation of methodology**	**727 days?**	**Tue 29/05/12**	**Wed 11/03/15**	**69**	**PB**
72	**Project Initiation**	**727 days?**	**Tue 29/05/12**	**Wed 11/03/15**		
73	GE internal hand-over-to-project process	7 days	Tue 29/05/12	Wed 06/06/12		GE-PM
74	PQP	3 days	Thu 07/06/12	Mon 11/06/12	73	GE-PM
75	High Level Solution Document	3 days	Tue 12/06/12	Thu 14/06/12	74	GE-TM
76	Baseline Plan	2 days	Tue 12/06/12	Wed 13/06/12	74	GE-PM
77	GE internal project kick-off process	5 days	Thu 14/06/12	Wed 20/06/12	76	GE-PM,GE-TM
78	External Kick-off Meeting	5 days	Thu 21/06/12	Wed 27/06/12	77	GE-PM,GE-TM,ENW
79	Customer Expectations Scorecard	1 day	Thu 28/06/12	Thu 28/06/12	78	ENW
80	**Requirements**	**38 days**	**Tue 29/05/12**	**Thu 19/07/12**		
81	Detailed Requirements Review	5 days	Tue 29/05/12	Mon 04/06/12		GE-PM,GE-TM,ENW
82	Business Process Capture	15 days	Tue 05/06/12	Mon 25/06/12	81	GE-PE,ENW
83	Business Process scenario tests	15 days	Tue 26/06/12	Mon 16/07/12	82	GE-PE,ENW
84	Agree Pilot Area	3 days	Tue 17/07/12	Thu 19/07/12	83	GE-TM,ENW
85	**Hardware and remote link**	**17 days**	**Tue 29/05/12**	**Wed 20/06/12**		
86	Procure Hardware & 3rd party SW	2 days	Tue 29/05/12	Wed 30/05/12		GE-PM
87	ENMAC Server and client	5 days	Thu 31/05/12	Wed 06/06/12	86	GE-PE
88	setup remote link	10 days	Thu 07/06/12	Wed 20/06/12	87	GE-IT
89	**Product modules Implementation**	**170 days**	**Tue 29/05/12**	**Mon 21/01/13**		
90	NMS default Implementation	5 days	Thu 07/06/12	Wed 13/06/12	87	
91	**DPF default Implementation**	**30 days**	**Thu 14/06/12**	**Wed 25/07/12**	**90**	
92	Install default Configuration	5 days	Thu 14/06/12	Wed 20/06/12		GE-PE
93	workshop	5 days	Thu 21/06/12	Wed 27/06/12	92	GE-PE
94	Data Capture	20 days	Thu 28/06/12	Wed 25/07/12	93	GE-PE,ENW
95	**Interfaces Implementation**	**170 days**	**Tue 29/05/12**	**Mon 21/01/13**		
96	**workshop**	**5 days**	**Tue 29/05/12**	**Mon 04/06/12**		**GE-TM**
97	setup virtual machines	5 days	Tue 29/05/12	Mon 04/06/12		GE-IT
98	**GE SOAP&CIM IF dev**	**95 days**	**Tue 29/05/12**	**Mon 08/10/12**		



Project: ENW LCNF Corridor project
Date: Tue 09/08/11

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

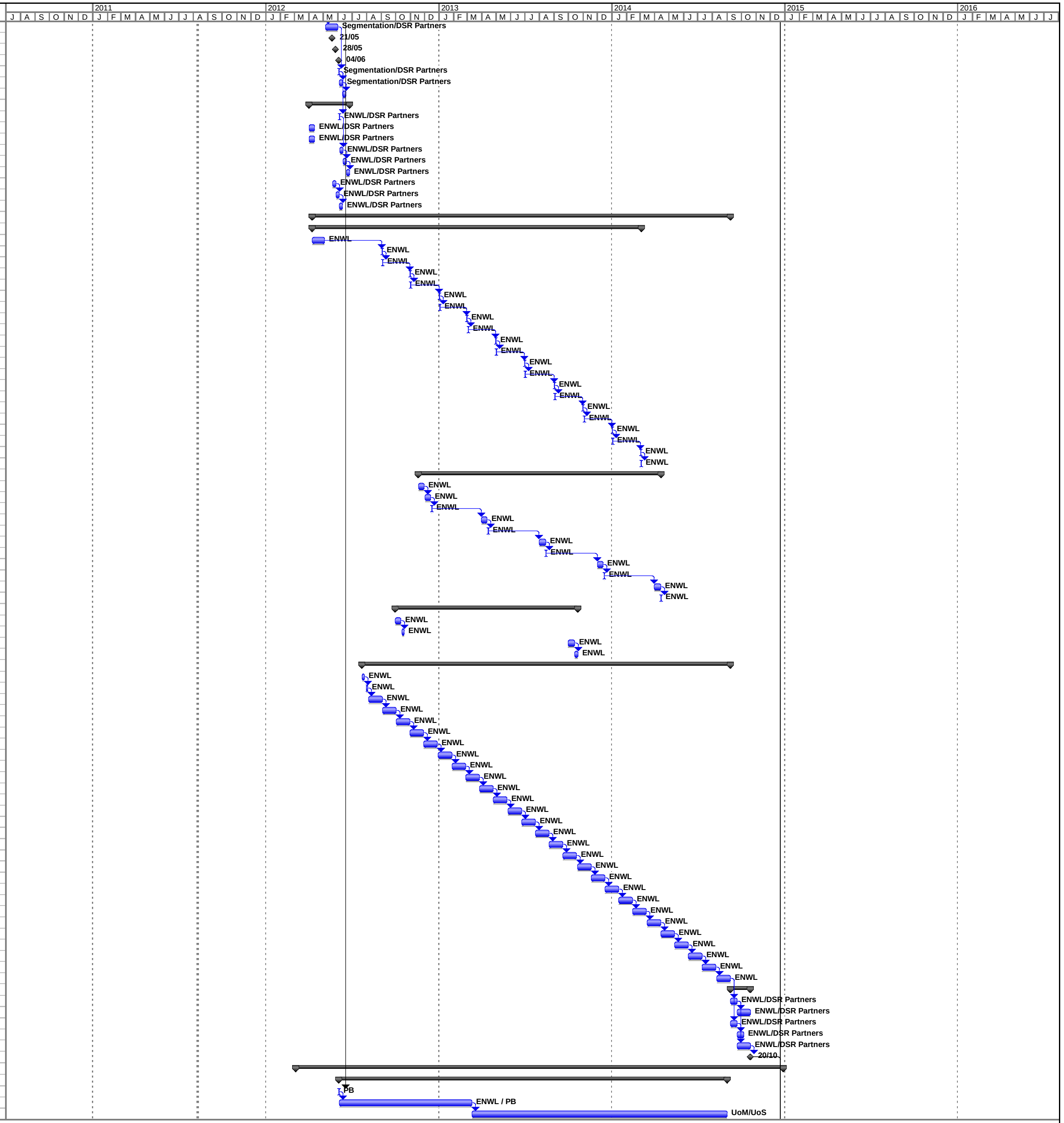
ID	Task Name	Duration	Start	Finish	Predeces	Resource Names
99	DML wrapper for bulk load and patch updates	35 days	Tue 29/05/12	Mon 16/07/12		GE-PE dev
100	Load flow - simulation	35 days	Tue 17/07/12	Mon 03/09/12	99	GE-PE dev
101	Load flow - invoke & report	25 days	Tue 04/09/12	Mon 08/10/12	100	GE-PE dev
102	SCADA analogues updates	25 days	Tue 29/05/12	Mon 02/07/12		GE-SSG
103	Switching updates	25 days	Tue 03/07/12	Mon 06/08/12	102	GE-SSG
104	Inhibits updates	25 days	Tue 07/08/12	Mon 10/09/12	103	GE-SSG
105	Query for the Loads	35 days	Tue 29/05/12	Mon 16/07/12		GE-PE dev
106	Query for the Loadings	35 days	Tue 17/07/12	Mon 03/09/12	105	GE-PE dev
107	Restoration/switching advisor	25 days	Tue 04/09/12	Mon 08/10/12	106	GE-PE dev
108	CIM for primary substations	70 days	Tue 29/05/12	Mon 03/09/12		GE-SSG
109	**ENW interfaces support**	**120 days**	**Tue 07/08/12**	**Mon 21/01/13**		
110	GE support to ENW	30 days	Tue 07/08/12	Mon 17/09/12	169SS+5	GE-PE
111	ENW CIM export complete	0 days	Mon 21/01/13	Mon 21/01/13	81,110,1	ENW
112	**Data Capture NMS/SCADA**	**175 days**	**Tue 07/08/12**	**Mon 08/04/13**	**81,97,16**	
113	**HV Schematic Diagram**	**25 days**	**Tue 07/08/12**	**Mon 10/09/12**	**84**	
114	**Analysis**	**10 days**	**Tue 07/08/12**	**Mon 20/08/12**		
115	Analyse Sources Data Content (HV & SCADA)	10 days	Tue 07/08/12	Mon 20/08/12		GE-PE,ENW
116	**Symbology**	**15 days**	**Tue 21/08/12**	**Mon 10/09/12**	**114**	
117	Symbol Mapping to PowerOn Fusion	15 days	Tue 21/08/12	Mon 10/09/12		GE-PE
118	**Data Load Pilot Test Phase**	**25 days**	**Mon 21/01/13**	**Mon 25/02/13**	**111,113**	
119	**Cycle 1**	**10 days**	**Mon 21/01/13**	**Mon 04/02/13**		
120	develop new symbols (@ 5 days/symbol)	0 days	Mon 21/01/13	Mon 21/01/13	117	GE-PE
121	run ENW CIM export	5 days	Tue 22/01/13	Mon 28/01/13		GE-PE,ENW
122	import Verification	5 days	Tue 29/01/13	Mon 04/02/13	121	GE-PE,ENW
123	**Corrections/Enhancements**	**5 days**	**Tue 05/02/13**	**Mon 11/02/13**	**119**	
124	ENW CIM export	5 days	Tue 05/02/13	Mon 11/02/13		ENW
125	**Cycle 2**	**10 days**	**Tue 12/02/13**	**Mon 25/02/13**	**123**	
126	run ENW CIM export	5 days	Tue 12/02/13	Mon 18/02/13		GE-PE,ENW
127	import Verification	5 days	Tue 19/02/13	Mon 25/02/13	126	GE-PE,ENW
128	**Bulk Data Load**	**10 days**	**Tue 26/02/13**	**Mon 11/03/13**	**118**	
129	Execute CIM import	10 days	Tue 26/02/13	Mon 11/03/13		GE-PE,ENW
130	**Diagram maintenance**	**20 days**	**Tue 12/03/13**	**Mon 08/04/13**	**128**	
131	Incremental updates	20 days	Tue 12/03/13	Mon 08/04/13		GE-PE,ENW
132	**Testing**	**37 days**	**Tue 06/08/13**	**Wed 25/09/13**	**211SS**	
133	**Pre-UAT on pilot**	**20 days**	**Tue 06/08/13**	**Mon 02/09/13**		
134	UAT Test Plan	5 days	Tue 06/08/13	Mon 12/08/13	83	GE-TM
135	Pre-UAT Testing running Business Process scenario tests	5 days	Tue 13/08/13	Mon 19/08/13	95,128,1	GE-TM,GE-PE
136	Pre-UAT Config and I/F Issue Resolution	7 days	Tue 20/08/13	Wed 28/08/13	135	GE-TM,GE-PE
137	Pre-UAT Report	3 days	Thu 29/08/13	Mon 02/09/13	136	
138	**UAT**	**17 days**	**Tue 03/09/13**	**Wed 25/09/13**	**133**	
139	Re-Stage Hardware on site, UAT upgrade and pre-Testing	5 days	Tue 03/09/13	Mon 09/09/13		GE-TM,GE-PE
140	UAT Testing	5 days	Tue 10/09/13	Mon 16/09/13	139	GE-TM,GE-PE,GE-PM
141	UAT config Issue Resolution	5 days	Tue 17/09/13	Mon 23/09/13	140	GE-TM,GE-PE
142	UAT Report	2 days	Tue 24/09/13	Wed 25/09/13	141	GE-TM
143	**Training**	**11 days**	**Fri 01/11/13**	**Fri 15/11/13**	**216SS**	
144	DMS overview prep	2 days	Fri 01/11/13	Mon 04/11/13		GE-PE
145	DMS overview	1 day	Tue 05/11/13	Tue 05/11/13	144	GE-PE
146	System Administration prep	3 days	Wed 06/11/13	Fri 08/11/13	145	GE-PE
147	System Administration	5 days	Mon 11/11/13	Fri 15/11/13	146	GE-PE
148	**Pilot**	**354 days**	**Fri 01/11/13**	**Wed 11/03/15**	**215**	
149	Pilot Strategy	5 days	Fri 01/11/13	Thu 07/11/13		ENW,GE-TM
150	Pilot GoLive	5 days	Fri 08/11/13	Thu 14/11/13	138,149	GE-TM,GE-PE,ENW
151	**18-months pilot**	**344 days**	**Fri 15/11/13**	**Wed 11/03/15**		
152	18-months pilot duration 2012	92 days	Fri 15/11/13	Mon 24/03/14	150	ENW
153	18-months pilot duration 2013	230 days	Tue 25/03/14	Mon 09/02/15	152	ENW
154	18-months pilot duration 2014	22 days	Tue 10/02/15	Wed 11/03/15	153	ENW
155	**ENW Software Development/Testing/Integration**	**425 days?**	**Tue 29/05/12**	**Mon 13/01/14**		
156	ENW PM Resource	425 days?	Tue 29/05/12	Mon 13/01/14		Project Manager
157	**Create New Interface between ARS and PowerOn LA/LF Engin**	**170 days?**	**Tue 29/05/12**	**Mon 21/01/13**		
163	**Implement C2C functionality for CRMS**	**140 days?**	**Tue 22/01/13**	**Mon 05/08/13**	**157**	
169	**Develop the CRMS/PowerOn (SOAP) Interface**	**170 days?**	**Tue 29/05/12**	**Mon 21/01/13**		
175	**CRMS Diagram changes/Managed Loads**	**105 days?**	**Tue 22/01/13**	**Mon 17/06/13**	**169**	
181	**LA storage for results**	**122 days?**	**Tue 22/01/13**	**Wed 10/07/13**	**169**	
188	**Data capture/cleanse**	**109 days?**	**Tue 29/05/12**	**Fri 26/10/12**		
193	**Initial data load functionality**	**105 days?**	**Mon 29/10/12**	**Fri 22/03/13**	**188**	
199	**Real-time data update functionality**	**105 days?**	**Mon 07/01/13**	**Fri 31/05/13**	**193SS+5**	
205	**C2C CRMS Reporting capability**	**22 days?**	**Mon 03/06/13**	**Tue 02/07/13**	**199**	
211	**System Integration & Testing**	**63 days?**	**Tue 06/08/13**	**Thu 31/10/13**	**157,163,1**	
216	**Training**	**12 days?**	**Fri 01/11/13**	**Mon 18/11/13**	**211**	
217	Users	11 days?	Fri 01/11/13	Fri 15/11/13		Ops Resource
218	Technology training for developers etc	1 day?	Mon 18/11/13	Mon 18/11/13	217	Developer
219	**Field Deployment**	**191 days?**	**Tue 29/05/12**	**Tue 19/02/13**		
220	Procure RTU/Actuators	1 day?	Tue 29/05/12	Tue 29/05/12		
221	Procure Monitoring Kit	1 day?	Tue 29/05/12	Tue 29/05/12		
222	Install RTU/Actuators	130 days	Wed 11/07/12	Tue 08/01/13	220FS+3	RTU Installer Contract
223	Commission RTU/Actuators	130 days	Wed 22/08/12	Tue 19/02/13	222SS+3	RTU Installer Contract
224	SCADA Commisioning	130 days	Wed 22/08/12	Tue 19/02/13	222SS+3	SCADA engineers
225	ARS	130 days	Wed 22/08/12	Tue 19/02/13	222SS+3	SCADA engineers
226	Install Monitoring Devices	130 days	Wed 11/07/12	Tue 08/01/13	221FS+3	RTU Installer Contract
227	**Phase 2 complete**	0 days	Tue 08/01/13	Tue 08/01/13	226	
228	**Phase 3 - Commercial Development**	**666 days?**	**Mon 02/04/12**	**Mon 20/10/14**		
229	**DSM Customer Survey & Segmentation**	**56 days?**	**Mon 02/04/12**	**Mon 18/06/12**		
230	**Segmentation**	**45 days?**	**Mon 02/04/12**	**Fri 01/06/12**		
231	Retrieve customer database	1 day?	Mon 02/04/12	Mon 02/04/12		Segmentation Partners
232	Assess level of information avliable	10 days	Tue 03/04/12	Mon 16/04/12	231	Segmentation Partners
233	Apply pre defined post code and industry codes	5 days	Tue 17/04/12	Mon 23/04/12	232	Segmentation Partners
234	Cross reference with PB circuit selection data	5 days	Tue 24/04/12	Mon 30/04/12	233	Segmentation Partners
235	Cross reference with PSS surevy data	2 days	Tue 01/05/12	Wed 02/05/12	234	Segmentation Partners
236	Compile segmented view of customer database	5 days	Thu 03/05/12	Wed 09/05/12	235	Segmentation Partners
237	Identify attractive segments	5 days	Thu 10/05/12	Wed 16/05/12	236	Segmentation Partners
238	Develop generic segmentation approach	10 days?	Mon 21/05/12	Fri 01/06/12	237	
239	**Customer Survey**	**56 days**	**Mon 02/04/12**	**Mon 18/06/12**		
240	Development of first customer surevy draft	5 days	Mon 02/04/12	Fri 06/04/12		Segmentation/DSR Partners
241	Testing of survey	5 days	Mon 09/04/12	Fri 13/04/12	240	Segmentation/DSR Partners
242	Develeopment of second customer survey draft	5 days	Mon 16/04/12	Fri 20/04/12	241	Segmentation/DSR Partners
243	Identifcation of target segments for survey	5 days	Mon 23/04/12	Fri 27/04/12	242	Segmentation/DSR Partners
244	Tailoring of survey for customer segments	5 days	Mon 30/04/12	Fri 04/05/12	243	Segmentation/DSR Partners



Project: ENW LCNF Corridor project
Date: Tue 09/08/11

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

ID	Task Name	Duration	Start	Finish	Predeces	Resource Names
245	Delivery of customer surveys	20 days	Mon 07/05/12	Fri 01/06/12	244	Segmentation/DSR Partners
246	Workshop / Focus group 1	0 days	Mon 21/05/12	Mon 21/05/12		
247	Workshop / Focus group 2	0 days	Mon 28/05/12	Mon 28/05/12		
248	Workshop / Focus group 3	0 days	Mon 04/06/12	Mon 04/06/12		
249	Completition of customer surveys	1 day	Mon 04/06/12	Mon 04/06/12	245	Segmentation/DSR Partners
250	Analysis of customer survey results	5 days	Tue 05/06/12	Mon 11/06/12	249	Segmentation/DSR Partners
251	Conclusions drawn up	5 days	Tue 12/06/12	Mon 18/06/12	250	
252	**Commerical arrangement generation**	**62 days?**	**Mon 02/04/12**	**Tue 26/06/12**		
253	Cross reference of segmentation and survey results	1 day?	Tue 05/06/12	Tue 05/06/12	249	ENWL/DSR Partners
254	Desktop research into global DSM trends	10 days	Mon 02/04/12	Fri 13/04/12		ENWL/DSR Partners
255	desktop research into global DSM contracts and offers	10 days	Mon 02/04/12	Fri 13/04/12		ENWL/DSR Partners
256	Drafting/testing of commercial arrangement for existing customer 1	5 days	Wed 06/06/12	Tue 12/06/12	253	ENWL/DSR Partners
257	Drafting/testing of commercial arrangement for existing customer 2	5 days	Wed 13/06/12	Tue 19/06/12	256	ENWL/DSR Partners
258	Drafting/testing of commercial arrangement for existing customer 3	5 days	Wed 20/06/12	Tue 26/06/12	257	ENWL/DSR Partners
259	Drafting/testing of commercial arrangement for new connection custom	5 days	Tue 22/05/12	Mon 28/05/12		ENWL/DSR Partners
260	Drafting/testing of commercial arrangement for new connection custom	5 days	Tue 29/05/12	Mon 04/06/12	259	ENWL/DSR Partners
261	Drafting/testing of commercial arrangement for new connection custom	5 days	Tue 05/06/12	Mon 11/06/12	260	ENWL/DSR Partners
262	**Marketing campaign**	**631 days?**	**Mon 09/04/12**	**Mon 08/09/14**		
263	**Magazine advertisments**	**497 days?**	**Mon 09/04/12**	**Tue 04/03/14**		
264	Identification of appropriate trade publications	20 days	Mon 09/04/12	Fri 04/05/12		ENWL
265	Drafting of magazine advertisment 1	1 day?	Mon 03/09/12	Mon 03/09/12	264	ENWL
266	Placement of trade magazine advertisment 1	1 day?	Tue 04/09/12	Tue 04/09/12	265	ENWL
267	Drafting of magazine advertisment 2	1 day?	Thu 01/11/12	Thu 01/11/12	266	ENWL
268	Placement of trade magazine advertisment 2	1 day?	Fri 02/11/12	Fri 02/11/12	267	ENWL
269	Drafting of magazine advertisment 3	1 day?	Wed 02/01/13	Wed 02/01/13	268	ENWL
270	Placement of trade magazine advertisment 3	1 day?	Thu 03/01/13	Thu 03/01/13	269	ENWL
271	Drafting of magazine advertisment 4	1 day?	Fri 01/03/13	Fri 01/03/13	270	ENWL
272	Placement of trade magazine advertisment 4	1 day?	Mon 04/03/13	Mon 04/03/13	271	ENWL
273	Drafting of magazine advertisment 5	1 day?	Wed 01/05/13	Wed 01/05/13	272	ENWL
274	Placement of trade magazine advertisment 5	1 day?	Thu 02/05/13	Thu 02/05/13	273	ENWL
275	Drafting of magazine advertisment 6	1 day?	Mon 01/07/13	Mon 01/07/13	274	ENWL
276	Placement of trade magazine advertisment 6	1 day?	Tue 02/07/13	Tue 02/07/13	275	ENWL
277	Drafting of magazine advertisment 7	1 day?	Mon 02/09/13	Mon 02/09/13	276	ENWL
278	Placement of trade magazine advertisment 7	1 day?	Tue 03/09/13	Tue 03/09/13	277	ENWL
279	Drafting of magazine advertisment 8	1 day?	Fri 01/11/13	Fri 01/11/13	278	ENWL
280	Placement of trade magazine advertisment 8	1 day?	Mon 04/11/13	Mon 04/11/13	279	ENWL
281	Drafting of magazine advertisment 9	1 day?	Thu 02/01/14	Thu 02/01/14	280	ENWL
282	Placement of trade magazine advertisment 9	1 day?	Fri 03/01/14	Fri 03/01/14	281	ENWL
283	Drafting of magazine advertisment 10	1 day?	Mon 03/03/14	Mon 03/03/14	282	ENWL
284	Placement of trade magazine advertisment 10	1 day?	Tue 04/03/14	Tue 04/03/14	283	ENWL
285	**Workshops and Seminars**	**367 days?**	**Mon 19/11/12**	**Tue 15/04/14**		
286	Identification of customer groups for workshops and seminars	10 days	Mon 19/11/12	Fri 30/11/12		ENWL
287	Planning/advertising and preparation of workshops/seminar 1	10 days	Mon 03/12/12	Fri 14/12/12	286	ENWL
288	Delivery of workshop/seminar 1	1 day?	Mon 17/12/12	Mon 17/12/12	287	ENWL
289	Planning/advertising and preparation of workshops/seminar 2	10 days	Mon 01/04/13	Fri 12/04/13	288	ENWL
290	Delivery of workshop/seminar 2	1 day?	Mon 15/04/13	Mon 15/04/13	289	ENWL
291	Planning/advertising and preparation of workshops/seminar 3	10 days	Thu 01/08/13	Wed 14/08/13	290	ENWL
292	Delivery of workshop/seminar 3	1 day?	Thu 15/08/13	Thu 15/08/13	291	ENWL
293	Planning/advertising and preparation of workshops/seminar 4	10 days	Mon 02/12/13	Fri 13/12/13	292	ENWL
294	Delivery of workshop/seminar 4	1 day?	Mon 16/12/13	Mon 16/12/13	293	ENWL
295	Planning/advertising and preparation of workshops/seminar 5	10 days	Tue 01/04/14	Mon 14/04/14	294	ENWL
296	Delivery of workshop/seminar 5	1 day?	Tue 15/04/14	Tue 15/04/14	295	ENWL
297	**Phamphlets**	**276 days**	**Mon 01/10/12**	**Mon 21/10/13**		
298	Design and identification of audience for phamphlet 1	10 days	Mon 01/10/12	Fri 12/10/12		ENWL
299	Publicity phamphlet distribution 1	5 days	Mon 15/10/12	Fri 19/10/12	298	ENWL
300	Design and identification of audience for phamphlet 2	10 days	Tue 01/10/13	Mon 14/10/13		ENWL
301	Publicity phamphlet distribution 2	5 days	Tue 15/10/13	Mon 21/10/13	300	ENWL
302	**Customer emails**	**556 days**	**Mon 23/07/12**	**Mon 08/09/14**		
303	Compilation of suitable customer email address database	5 days	Mon 23/07/12	Fri 27/07/12		ENWL
304	Drafting of customer emails	3 days	Wed 01/08/12	Fri 03/08/12	303	ENWL
305	Publicity - customer emails 1	21 days	Mon 06/08/12	Mon 03/09/12	304	ENWL
306	Publicity - customer emails 2	21 days	Tue 04/09/12	Tue 02/10/12	305	ENWL
307	Publicity - customer emails 3	21 days	Wed 03/10/12	Wed 31/10/12	306	ENWL
308	Publicity - customer emails 4	21 days	Thu 01/11/12	Thu 29/11/12	307	ENWL
309	Publicity - customer emails 5	21 days	Fri 30/11/12	Fri 28/12/12	308	ENWL
310	Publicity - customer emails 6	21 days	Mon 31/12/12	Mon 28/01/13	309	ENWL
311	Publicity - customer emails 7	21 days	Tue 29/01/13	Tue 26/02/13	310	ENWL
312	Publicity - customer emails 8	21 days	Wed 27/02/13	Wed 27/03/13	311	ENWL
313	Publicity - customer emails 9	21 days	Thu 28/03/13	Thu 25/04/13	312	ENWL
314	Publicity - customer emails 10	21 days	Fri 26/04/13	Fri 24/05/13	313	ENWL
315	Publicity - customer emails 11	21 days	Mon 27/05/13	Mon 24/06/13	314	ENWL
316	Publicity - customer emails 12	21 days	Tue 25/06/13	Tue 23/07/13	315	ENWL
317	Publicity - customer emails 13	21 days	Wed 24/07/13	Wed 21/08/13	316	ENWL
318	Publicity - customer emails 14	21 days	Thu 22/08/13	Thu 19/09/13	317	ENWL
319	Publicity - customer emails 15	21 days	Fri 20/09/13	Fri 18/10/13	318	ENWL
320	Publicity - customer emails 16	21 days	Mon 21/10/13	Mon 18/11/13	319	ENWL
321	Publicity - customer emails 17	21 days	Tue 19/11/13	Tue 17/12/13	320	ENWL
322	Publicity - customer emails 18	21 days	Wed 18/12/13	Wed 15/01/14	321	ENWL
323	Publicity - customer emails 19	21 days	Thu 16/01/14	Thu 13/02/14	322	ENWL
324	Publicity - customer emails 20	21 days	Fri 14/02/14	Fri 14/03/14	323	ENWL
325	Publicity - customer emails 21	21 days	Mon 17/03/14	Mon 14/04/14	324	ENWL
326	Publicity - customer emails 22	21 days	Tue 15/04/14	Tue 13/05/14	325	ENWL
327	Publicity - customer emails 23	21 days	Wed 14/05/14	Wed 11/06/14	326	ENWL
328	Publicity - customer emails 24	21 days	Thu 12/06/14	Thu 10/07/14	327	ENWL
329	Publicity - customer emails 25	21 days	Fri 11/07/14	Fri 08/08/14	328	ENWL
330	Publicity - customer emails 26	21 days	Mon 11/08/14	Mon 08/09/14	329	ENWL
331	**DSM Evaluation**	**30 days**	**Tue 09/09/14**	**Mon 20/10/14**		
332	Evaluation of results of commerical arrangement	10 days	Tue 09/09/14	Mon 22/09/14	330	ENWL/DSR Partners
333	Industrialisation of new commerical arrangements	20 days	Tue 23/09/14	Mon 20/10/14	332	ENWL/DSR Partners
334	Key consulsions drafted	10 days	Tue 09/09/14	Mon 22/09/14	330	ENWL/DSR Partners
335	Recommendataions for successful DSM contracts	10 days	Tue 23/09/14	Mon 06/10/14	334	ENWL/DSR Partners
336	Material creation for learning and dissemination	20 days	Tue 23/09/14	Mon 20/10/14	332	ENWL/DSR Partners
337	**Phase 3 complete**	0 days	Mon 20/10/14	Mon 20/10/14	336	
338	**Phase 4 - Learning and Dissemination**	**736 days?**	**Mon 05/03/12**	**Mon 29/12/14**		
339	**Data Capture**	**586 days?**	**Mon 04/06/12**	**Mon 01/09/14**		
340	Identification of circuits to install monitoring equipment on	1 day?	Mon 04/06/12	Mon 04/06/12	70	PB
341	Installation of monitoring equipment	200 days	Tue 05/06/12	Mon 11/03/13	340	ENWL / PB
342	Network data capture	385 days	Tue 12/03/13	Mon 01/09/14	341	UoM/UoS



Project: ENW LCNF Corridor project
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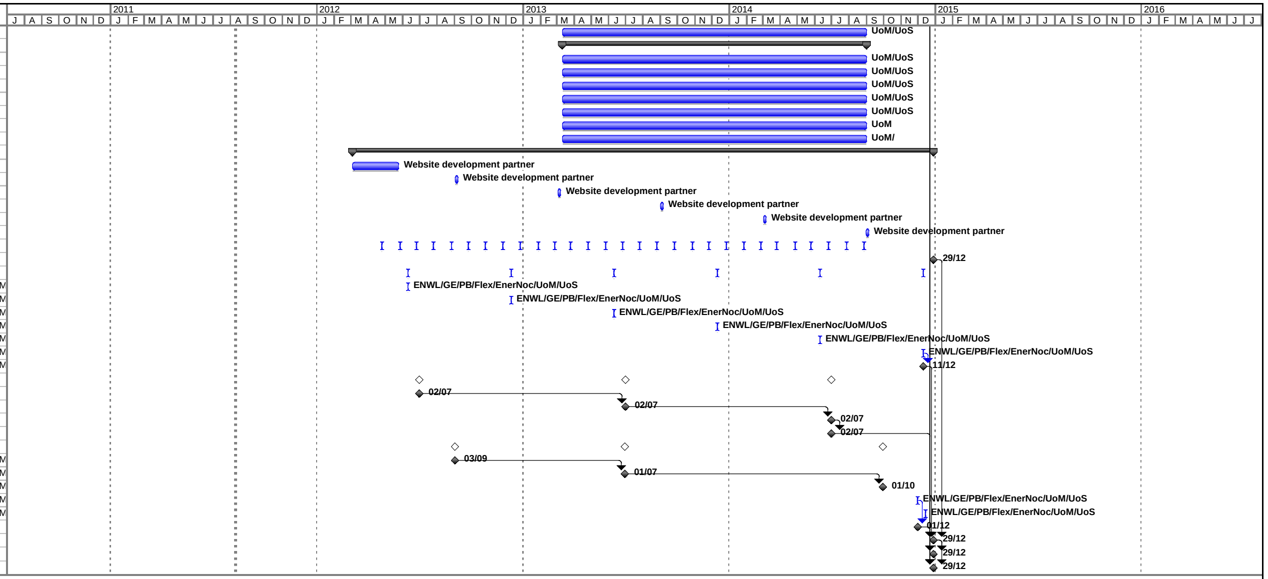
Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

ID	Task Name	Duration	Start	Finish	Predeces	Resource Names
343	Uploading data to webiste data repository	385 days?	Tue 12/03/13	Mon 01/09/14		UoM/UoS
344	**Data Modelling and Simulation**	**385 days?**	**Tue 12/03/13**	**Mon 01/09/14**		
345	Simulation of network data to identify upper limits	385 days	Tue 12/03/13	Mon 01/09/14		UoM/UoS
346	Simulation of data to identify capacity released	385 days?	Tue 12/03/13	Mon 01/09/14		UoM/UoS
347	Simulation of losses data	385 days?	Tue 12/03/13	Mon 01/09/14		UoM/UoS
348	Simulation of power quality data	385 days?	Tue 12/03/13	Mon 01/09/14		UoM/UoS
349	Simulation of reliability data	385 days?	Tue 12/03/13	Mon 01/09/14		UoM/UoS
350	Carbon modelling	385 days?	Tue 12/03/13	Mon 01/09/14		UoM
351	Economic modelling	385 days?	Tue 12/03/13	Mon 01/09/14		UoM/
352	**Learning and dissemination**	**736 days?**	**Mon 05/03/12**	**Mon 29/12/14**		**ENWL**
353	Design and creation of ENWL LCNF website	60 days	Mon 05/03/12	Fri 25/05/12		Website development partner
354	Website maintenance 1	5 days	Mon 03/09/12	Fri 07/09/12		Website development partner
355	Website maintenance 2	5 days	Mon 04/03/13	Fri 08/03/13		Website development partner
356	Website maintenance 3	5 days	Mon 02/09/13	Fri 06/09/13		Website development partner
357	Website maintenance 4	5 days	Mon 03/03/14	Fri 07/03/14		Website development partner
358	Website maintenance 5	5 days	Mon 01/09/14	Fri 05/09/14		Website development partner
359	**Project learning and outcome capture -Web Site updates**	**698 days?**	**Thu 26/04/12**	**Mon 29/12/14**		
394	Web site phase complete	0 days	Mon 29/12/14	Mon 29/12/14	393	ENWL
395	**Learning outcome - publish white papers**	**654 days**	**Mon 11/06/12**	**Thu 11/12/14**		
396	Learning outcome - publish white papers 1	1 day	Mon 11/06/12	Mon 11/06/12		ENWL/GE/PB/Flex/EnerNoc/UoM
397	Learning outcome - publish white papers 2	1 day	Tue 11/12/12	Tue 11/12/12		ENWL/GE/PB/Flex/EnerNoc/UoM
398	Learning outcome - publish white papers 3	1 day	Tue 11/06/13	Tue 11/06/13		ENWL/GE/PB/Flex/EnerNoc/UoM
399	Learning outcome - publish white papers 4	1 day	Wed 11/12/13	Wed 11/12/13		ENWL/GE/PB/Flex/EnerNoc/UoM
400	Learning outcome - publish white papers 5	1 day	Wed 11/06/14	Wed 11/06/14		ENWL/GE/PB/Flex/EnerNoc/UoM
401	Learning outcome - publish white papers 6	1 day	Thu 11/12/14	Thu 11/12/14		ENWL/GE/PB/Flex/EnerNoc/UoM
402	Publications complete	0 days	Thu 11/12/14	Thu 11/12/14	401	ENWL/GE/PB/Flex/EnerNoc/UoM
403	**Presentation at DNO forums/Seminars**	**522 days**	**Mon 02/07/12**	**Wed 02/07/14**		
404	Presentation at DNO forums/Seminar 1	0 days	Mon 02/07/12	Mon 02/07/12		ENWL
405	Presentation at DNO forums/Seminar 2	0 days	Tue 02/07/13	Tue 02/07/13	404	ENWL
406	Presentation at DNO forums/Seminar 3	0 days	Wed 02/07/14	Wed 02/07/14	405	ENWL
407	Presentations complete	0 days	Wed 02/07/14	Wed 02/07/14	406	ENWL
408	**Presentation at Indiustry Conferences**	**596 days?**	**Mon 03/09/12**	**Mon 15/12/14**		
409	Presentation at Indiustry Conferences 1	0 days	Mon 03/09/12	Mon 03/09/12		ENWL/GE/PB/Flex/EnerNoc/UoM
410	Presentation at Indiustry Conferences 2	0 days	Mon 01/07/13	Mon 01/07/13	409	ENWL/GE/PB/Flex/EnerNoc/UoM
411	Presentation at Indiustry Conferences 3	0 days	Wed 01/10/14	Wed 01/10/14	410	ENWL/GE/PB/Flex/EnerNoc/UoM
412	Presentation at Indiustry Conferences 4	1 day?	Mon 01/12/14	Mon 01/12/14		ENWL/GE/PB/Flex/EnerNoc/UoM
413	Presentation at Indiustry Conferences 5	1 day?	Mon 15/12/14	Mon 15/12/14		ENWL/GE/PB/Flex/EnerNoc/UoM
414	Conferences complete	0 days	Mon 01/12/14	Mon 01/12/14	412	
415	**Phase 4 completed**	0 days	Mon 29/12/14	Mon 29/12/14	394,402,4	
416	**Project completed**	0 days	Mon 29/12/14	Mon 29/12/14	64,227,33	
417	**Project closed down report published. Project Conference to launch reports and find**	0 days	Mon 29/12/14	Mon 29/12/14	24,64,227	ENWL



Project: ENW LCNF Corridor project Date: Tue 09/08/11	Task	Split	Progress	Milestone	Summary	Project Summary	External Tasks	External Milestone	Deadline

Appendix 3: Project Partner Information

Name	Relationship to DNO	Type of Organisation	Funding Provided	Contractual Relationship	Benefits for Partner
Flexitricity	None	Flexitricity developed, owns and operates the UK's largest and most technically advanced smart grid system. Flexitricity provides demand response to utility clients by aggregating flexible consumption and generation at industrial and commercial sites.	None	Signed member of C_2C consortium agreement	Flexitricity will benefit from learning on post fault demand response commercial agreements and technical requirements
GE	None	GE Energy is one of the world's leading suppliers of power generation and energy delivery technologies	TBC	Signed an Memorandum of Understanding	GE will benefit from developing the technical solution that can be potentially licensed to other industry participants
nPower	None	nPower is a leading integrated UK energy company. Npower supply gas, electricity and related services to residential and business customers	None	Signed member of C_2C consortium agreement	TBC
Uni. Of Manchester	None	The University of Manchester is a public research university	None	Signed member of C_2C consortium agreement	Access to real time data
Uni. Of Strathclyde	None	The University of Strathclyde is a public research university	None	Signed member of C_2C consortium agreement	Access to real time data
EnerNoc	Signed 5 years demand response agreement in May 2011	EnerNOC develops and provides energy solutions to commercial, institutional, and industrial (I&C) customers, as well as electric power grid operators and utilities.	None	Signed member of C_2C consortium agreement	EnerNoc will benefit from learning on post fault demand response commercial agreements and technical requirements
Parsons Brinckerhoff	Existing supplier of professional engineering consultancy services through a framework agreement	PB is a leader in the development and operation of infrastructure to meet the needs of communities around the world.	None	Signed member of C_2C consortium agreement	

Appendix 5: Derogation and Exceptions. Application for a Definite Derogation from Standard Licence Condition 24.1(a)

1. Outline of Derogation Request

Electricity North West Limited is seeking a Definite Derogation from its Standard Licence Condition 24.1(a); to plan and develop its distribution system in accordance with a standard not less than that set out in Engineering Recommendation P.2/6 (ER P2/6) of the Energy Networks Association so far as that standard is applicable to it.

Electricity North West Limited has submitted a Second Tier Low Carbon Networks Fund proposal to Ofgem for the 2011/12 funding round. This proposal is termed Capacity to Customers (C_2C) and seeks to release and utilise latent network capacity to facilitate the connection of new demands and generation associated with a low carbon future, without the requirement to reinforce the network. The utilisation of latent network capacity will potentially make the relevant area of network non-compliant with the planning requirements of ER P2/6. It is anticipated that all classes of supply (except Class F) may become ER P2/6 non-compliant as a result of the C_2C Project.

The C_2C Project will be applied to an existing area of network that is currently (ie at the date of the application) fully compliant with the requirements of ER P2/6.

2. Background to the potential non-compliance

ER P2/6 lays down the security of supply to customers based on the aggregation of their demand as it appears across the network. In its simplest form, the application of Table 1 in ER P2/6 requires that Distribution Network Operators increase the capacity available from their network as certain thresholds of loading are reached, such that certain quantities of demand can always be supplied when capacity becomes unavailable due to faults or planned network activities.

The application of Table 1 means that the network supporting demand greater than 1 MW is always duplicated. At the highest voltages it is common for circuits to be duplicated or even triplicated. C_2C intends to make use of this duplicated capacity through the twin approach of new technical approaches and through creating a demand side response from customers so that when capacity becomes unavailable, customer demands will be reduced to a level that the remaining network, including contiguous networks, can support.

As C_2C is applied, the unconstrained demands from customers will grow beyond the levels that would generally otherwise trigger reinforcement to stay within the parameters defined in Table 1 of ER P2/6. This means that the network cannot support customers' unconstrained demand for outages of Electricity North West's circuitry, and hence is non compliant with ER P2/6. In practice under C_2C customers who have contracted to reduce demand under these circumstances will do so, and bring the demand down to the level that the total network will support with the relevant outage. This will be achieved by control room switching of customer's contractually reducible demand.

C2C as a Project is aimed at proving the approach on 6.6kV and 11kV feeders. The typical maximum supported on a pair of such feeders is about 8MW (for 11kV networks), ie within ER P2/6 class B. To maximize the security and other benefits, it is intended to run such circuits in a closed ring configuration. C2C introduces system automation to maintain supplies to customers following unplanned outages (ie faults). Faults on HV closed rings will cause both feeding circuit breakers to trip, and the C2C automation will then isolate the faulty leg of the ring, and restore supplies to the rest all within 3 minutes.

The application of C_2C techniques to a number of feeders within a bounded area of network could mean that in aggregate there is an effect higher up the system, eg at primary substations or on the 33kV and 132kV networks. Therefore, without reinforcement of the upstream network they too will become ER P2/6 non-compliant with the take-up of C_2C.

Where higher loads occur on EHV networks coincident with outages, C_2C will use adaptive network automation techniques (control system software algorithms developed by Electricity North West) to reconfigure the network circuitry automatically so as to sustain or restore supplies to customers and simultaneously activate demand side response via participating customers. For example the adaptive network techniques will utilise the transfer capacity of interconnected EHV networks to restore supplies to manage constraints.

Critically, ER P2/6 does not recognise demand side response and its contribution to the capability of a network to meet demand. It is the application of demand side management techniques within C_2C that drives ER P2/6 non-compliance.

3. Impact of non-compliance

Electricity North West seeks a Direct Derogation under Standard Licence Condition 24.2 from Standard Licence Condition 24.1(a) in respect of the demand groups specified in Schedule A to this document. The Derogation is sought for the period of duration of the C_2C Project. The duration of Project C_2C is 3 years. Electricity North West has assessed the impact of the non-compliance and believes that there are no significant risks both to itself or to other relevant licensees or connected consumers. Detail of the assessment is provided in the following paragraphs.

3.1 Consumers

It is anticipated that consumers within the C_2C Project area may experience an increase in short duration interruptions. However, the circuits selected for C_2C are historically well performing (under the Interruption Incentive Scheme) areas of network and therefore any potential increase in short duration interruptions will not be significant and mitigated by the reduction in the length of the interruption due to the installation of the remote control onto the circuit.
The C_2C Project will report the performance (under the Interruption Incentive Scheme).of the circuits in the Project area.

This level of performance relies on the successful implementation and operation of the system automation. Electricity North West has extensive experience in the application of these automation systems on poor performing HV circuits that has delivered improved performance. There is therefore high confidence in the application of the automation systems and it is anticipated that there will be no degradation in the level of security experienced by consumers.
In the event of failure of the automation systems all supplies will be restored by manual switching. The restoration timescale will be typically that of an HV fault, currently about 50 minutes.

An integral part of the C_2C Project is the Customer Engagement Plan that will disseminate information about the Project and its likely impact to those customers that are supplied from network in the Project area. The Customer Engagement Plan describes the process to manage customer queries and objections.

3.2 Security of Supply

It is anticipated that the C_2C Project area will encompass network that supplies approximately 300 000 consumers. Consumers within the C_2C Project area that are not actively participating in the Project (ie not contracted for demand side response) will not see a change to their present level of security of supply.

Consumers who have contracted for demand side response following a network event as part of Project C_2C will reduce load or generation upon receipt of a signal from Electricity North West's control systems. Those consumers will therefore be reconnected as the system is restored, but at the lower level demands that they have contracted to present to the network under outage conditions

3.3 Competition

The C_2C Project and this derogation will not have an adverse impact on competition.
Electricity North West will offer the same opportunities to connect within the C_2C Project area to Independent Connection Providers (ICP) and Independent Distribution Network Operators (IDNO). Consumers, ICPs and IDNOs outside of the C_2C Project area will not be afforded the same connection terms available to those within the Project area. The C_2C Project and the designated circuits within the Project will be clearly defined and communicated at the onset of the Project.
Electricity North West recognises that in many instances the connecting party will not be the final consumer. Electricity North West will protect the consumer through commercial arrangements with the connection party.

3.4 Sustainable development

The C_2C Project is designed to minimise new network assets needed to support growth in demand. As Great Britain decarbonises the fuel sources used for space heating and for transport, more electricity will be required in substitution. Reinforcement of electricity networks is itself an energy intensive activity, with network components (transformers, conductors, insulation etc) containing high levels of embedded carbon, and with carbon intensive installation techniques (eg excavating and burying cable; reinstatement of paved/bituminous surfaces).

The C_2C Project will minimise the amount of new HV and EHV network needing to be installed or reinforced, thus minimizing the consumption of energy and other resources.
For the HV network, the move to closed rings for the C_2C Project application will reduce network losses. In the longer term losses will rise with increasing demand. However, long term losses with C_2C will be less than with a continuation of the current design and operating standards.

3.5 Health and safety

The only change to the network that represents a theoretical adverse impact to the current health and safety risks of operation the distribution network is; the operation of HV closed rings and application of automation systems. However Electricity North West does not believe that this delivers an adverse health and safety impact because the feeder protection at the source primary substation will remain unchanged from that which currently protects the feeder. Furthermore, Electricity North West have applied automation systems extensively on poorly performing circuits and are experienced in managing the operational risk.

3.6 Other parties affected

Any other DNO or IDNO connected to Electricity North West's distribution network that forms part of the C_2C Project will be fully informed. It is not anticipated that their licence compliance will be affected in any way by this Project. They may choose to actively participate in the Project by commitment to a demand side response.

National Grid Electricity Transmission (NGET) is a C_2C Project Partner. NGET will assess the impact of increased demand on their ability to comply with their licence requirements and we will limit the increase in demand on the C_2C trial networks so to ensure SQSS compliance is maintained.

4. Business case for non-compliance

This Definite Derogation is sought in relation to the Second Tier Low Carbon Networks Fund' C_2C Project application. The business case, implementation plan and further supporting evidence are provided with that application.

5. Restoration of Compliance

The findings from the completion of the C_2C Project will direct the method by which compliance will be restored. If the C_2C Project is successful, it is anticipated that ER P2/6 is redrafted to include demand side response as a technique to deliver security of supply.

Should the C_2C Project fail to deliver the anticipated benefits then restoration of ER P2/6 compliance will be achieved by appropriate reinforcement of the network. The time to restore compliance will depend on the extent of any reinforcement required. As soon as Electricity North West is aware it will seek an extension to this derogation stating the time period to restore compliance

Schedule A – ER P2/6 Groups of Demand within C_2C Project area

ER P2/6 Group Demand Description/Location	ER P2/6 Class	Voltage	Significant customers/IDNOs etc

Customer Engagement Plan

Capacity to Customers (C_2C) Project

This Customer Engagement Plan was approved by Ofgem on [date]

To be published on Electricity North West's website

Produced by: Joe Ashe
Date: 1 August 2011
Version No: 1.0

CONTENTS

1. INTRODUCTION - PROJECT BACKGROUND

Ofgem, the gas and electricity regulator, created an innovation funding mechanism, called the Low Carbon Networks Fund (LCN Fund), for distribution network operators in April 2010. The LCN Fund is designed to assist the distribution networks operators to understand the role they can play in the transition to the low carbon economy.

Electricity North West has been awarded funding to undertake its Capacity to Customer (C_2C) Project. The Project will start in January 2012 and run for three years, finishing in December 2014. Throughout this three year period Electricity North West will engage with potential and existing customers to explain the scope of the C_2C Project.

This plan describes why, how and when Electricity North West will engage with customers as part of the C_2C Project.

2. CUSTOMER ENGAGEMENT STRATEGY

Electricity North West aims to:

engage with the wider community to publicise the C_2C Project;

engage with every customer impacted by the C_2C Project; and

have special regard to Priority Service Register (PSR) customers involved in the C_2C Project.

This Plan details how Electricity North West and its Project Partners, will engage with, or impact upon, customers during the C_2C Project:

- to provide general information about the C_2C Project and how to take part in one of the trials;
- to advise them of planned interruptions to supply to install monitoring equipment at substations; or
- to gain their consent to install remote controlled and/or monitoring equipment at their premises; and
- to respond to individual customer queries or complaints.
- It also details how Electricity North West plans to engage with stakeholders including Ofgem, Suppliers, partners and other DNOs.

This Plan complies with Electricity North West's Statement of Good Practice shown at Appendix 6a.

3. CUSTOMER IMPACT

Scope of C_2C Project

The C_2C Project will ascertain whether it is possible to release the whole of the installed network capacity for use by new and existing customers thereby reducing the costs for developing the distribution network. To trial the release of the installed network capacity Electricity North West will select 360 high voltage (HV) circuits and through the application of network monitoring and automation equipment and the development of enhanced control systems reconfigure the operational arrangements of these circuits to create 180 closed HV rings. To offer the capacity released Electricity North West needs to make arrangements for Demand Side and/or Generation Response to be available at times of network stress ie following a network incident which causes a supply interruption.

Impact on Customers connected to the trial HV circuits

The following potential impacts have been identified:

1. Electricity North West intends to undertake a customer survey of the industrial and commercial customers connected to the trial HV circuits with the aim of understanding the propensity of these customers to enter into demand side response contractual arrangements. The results from this survey will enable Electricity North West to understand the size of the demand side market and how to segment the market.
2. It may be necessary to interrupt the electricity supply to install the monitoring equipment at distribution substations to evaluate the losses and power quality performance of the closed HV rings.
3. The reconfiguration of the HV circuits into closed HV rings potentially may result in an increase in short duration interruptions. But the application of automation on the closed HV ring will result in the shorter than average interruption period experienced. There is no reduction in the security of supply.

Impact on Customers providing Demand Side Response

The following potential impacts have been identified:

1. Electricity North West or a Project Partner will discuss the details, commercial and technical arrangements and potential benefits of involvement of the Demand Side Response program with the customer.
2. Once the contractual arrangements have been concluded, Electricity North West will make arrangements to install the remote control, monitoring and communications equipment at the customer's premises to facilitate the required demand side response. It may be necessary to interrupt the electricity supply to the customer to install this equipment but any planned supply interruption will be discussed and agreed with the customer.

Impact on New Customers seeking a Connection to a trial HV circuit

The following potential impacts have been identified:

1. Electricity North West will discuss the details, commercial and technical arrangements and potential benefits of providing a Demand Side Response as part of the connection offer.
2. Once the contractual arrangements have been concluded, Electricity North West will agree with the customer the arrangements to install the remote control, monitoring and communications equipment at the customer's premises to facilitate the required Demand Side Response.

4. PRIOIRTY SERVICES REGISTER (PSR) CUSTOMERS

Electricity North West promotes safety and security at home to elderly and other vulnerable customers. Throughout the C_2C project we will have regard to the impact on our PSR customers and we will plan and implement the Project in ways that minimises the impact on our PSR customers.

For example and in accordance with our normal Planned Supply Interruption procedures we will, in addition to a written notification, ring PSR customers in advance of a planned supply interruption. In particular we will take account of the needs of customers who depend on electrical equipment for medical needs.

5. PROVIDING INFORMATION

General Information

Electricity North West will publicise the C_2C Project to customers, stakeholders and the wider community through the local and national media.

We will create a new micro site (www.enwl.co.uk/capacitytocustomers) as part of the Electricity North West's website providing general and detailed information of the C_2C Project, as well as contact details and FAQs. The Project website will be the hub for all information relating to the C_2C Project

Information for all customers

We will publicise the scope, size and the areas of the distribution network included within the C_2C Project in the local media and on the project website.

Information for New Connections

A small dedicated team within Electricity North West's Connections business will manage the customer contact for new connections wishing to be part of the C_2C Project. All new connection applications, above 100kW and expecting to incur reinforcement costs, within the project area will receive a standard network solution connection offer and information on the C_2C Project. Appendix 6B.1 shows the overall process. Included in the standard connection offer will be some briefing material outlining the C_2C Project (see Appendix 6B.1 of the C_2C project information within the connection offer). The Connections team will create and issue a C_2C connection offer (see Appendix 6B.2 of the C_2C connection offer) after the initial connection offer and would then follow up with the customer to discuss both connection offers, if the customer agrees.

We have agreed with Ofgem to record and report our performance in creating and discussing the options with the customer as this information would assist with the development of a future standard.

Information on the C_2C connection offer process will be published on the Connections website at http://www.enwl.co.uk/Content/OurServices/ElectricityConnections.aspx.

Information for existing customers interested in providing a Demand Side Response

An important part of the C_2C Project is to ascertain whether customer will be willing and able to provide demand side response and/ or generation side response to Electricity North West. Our Project Partners: RWE nPower, EnerNOC and Flexitricity will engage with existing customers to purchase DSR and/ or GSR services from existing customers connected on the HV circuits identified within the C_2C Project.

Customers affected by planned supply interruptions for installation of monitoring equipment

The installation of monitoring equipment to the distribution networks may require the interruption to supply to a number of high voltage substations. We will advise stakeholders of the areas affected via the C_2C Project website and we will contact those customers directly affected, detailing the equipment installation dates.

Information for Suppliers

We will advise Electricity Suppliers of the postcode areas and dates in which we plan to contact affected customers of the equipment installation.

Information for Project Partners and Other Interested Parties

We will provide regular updates to interested parties.
We will share our learning experience of the C_2C Project outcome with interested parties, including other DNOs and academic institutions throughout the C_2C Project.

Alternative Formats

Electricity North West will make all customer information about the C_2C Project available in alternative formats such as audio CD, Braille or minority languages on request.

6. PARTNERSHIP WORKING

Electricity North West is working in partnership with the following organisations in the C_2C Project:
GE Digital Energy;
Parsons Bickernoff;
University of Manchester;
University of Strathclyde;
National Grid Electricity Transmission
RWE npower;
EnerNOC; and
Flexitricity.

7. FACILITIES TO HANDLE ENQUIRIES

C_2C Project website

Information on the C_2C project will be available on a section of Electricity North West's website (www.enwl.co.uk/capacitytocustomers) providing details of the project, FAQs and contact details.

Enquiries

Customers can ask questions or raise queries related to the C_2C Project using the following channels:

Telephone

Electricity North West operates an enquiry service that is continuously staffed and can be contacted 24 hours a day on 0800 1954141. There will be a specific IVR option available for LCNF enquiries.

Written correspondence

The C_2C Project Team will handle general enquiries from customers and stakeholders.

Post

Customer can contact the project team by post at the following address:
C_2C Project Team
304 Bridgewater Place
Birchwood Park
Warrington
WA3 6XG

Email

Customers can contact the project team at the following email address:
futurenetworks@enwl.co.uk for any queries.

8. FEEDBACK & REVIEW

Customers

Through the C_2C Project and in all the activities which involves engagement with our customers we will seek feedback on the customer experiences. We will use a postal form and web based survey form to obtain feedback from customers (see Appendix 6C of the generic customer feedback form) and we will use the results of the feedback to amend our processes.

DNOs, Project Partners and Interested Parties

We will work with partners to disseminate the learning points from the Project, and seek feedback from interested parties.

APPENDIX 6a. STATEMENT OF GOOD PRACTICE

In accordance with paragraph 3.14 of Ofgem's Low Carbon Networks Fund Governance Document v.4, Electricity North West has prepared a statement of good practice in respect of such engagement with customers.

Electricity North West LIMITED

STATEMENT OF GOOD PRACTICE ON ENGAGEMENT WITH CUSTOMERS WHERE ACCESS TO CUSTOMERS PREMISES IS REQUIRED AS PART OF A SECOND TIER LOW CARBON NETWORKS FUND PROJECT

Electricity North West Limited (Electricity North West) recognises that access to customers' premises may be required for the following reasons when undertaking the Second Tier Low Carbon Networks Fund Capacity to Customers Project to:

1. Brief the customer on aspects of the C_2C Project:
    a. Discuss/ complete the Demand Side Response Customer Survey;
    b. Discuss a connection offer with the customer;
    c. Discuss a Demand Side Response contract
2. Installation (and decommissioning) of equipment at customer's premises:
    a. Install remote control and power quality / voltage monitoring equipment and related communication system equipment at a customer's premises for the Demand Side Response program

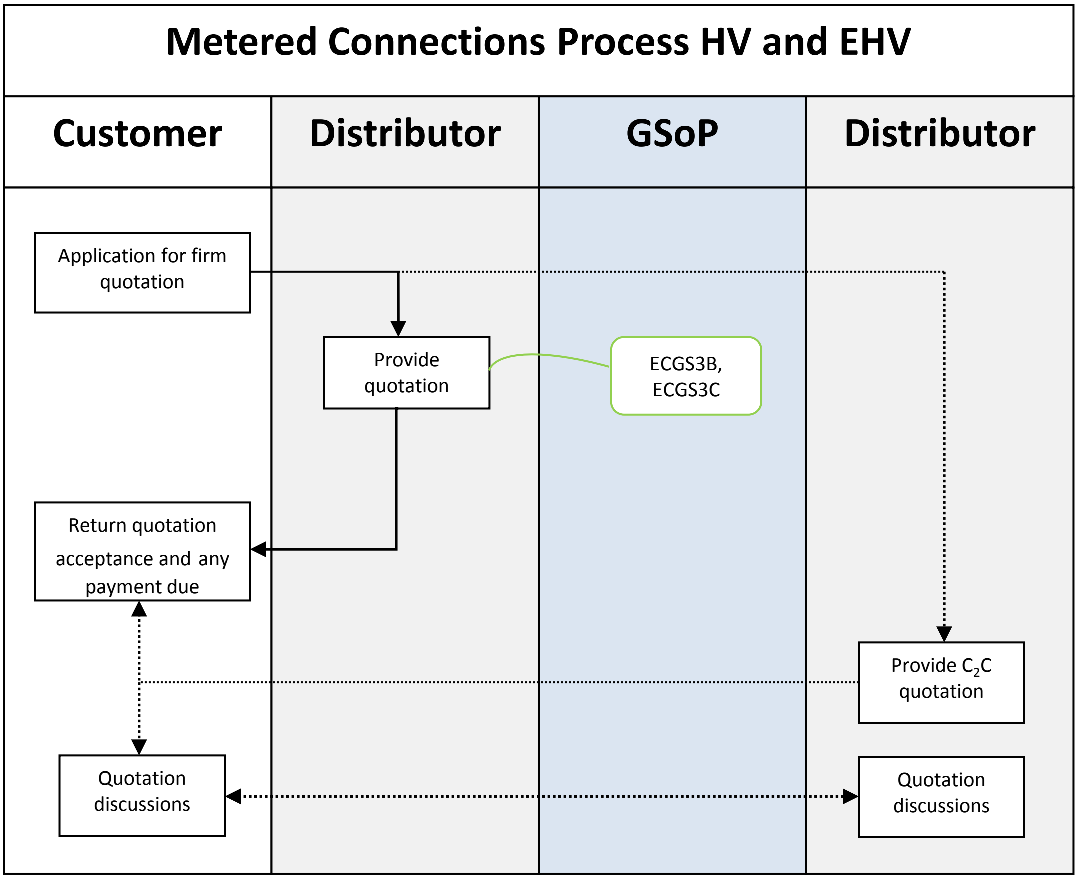
Electricity North West commits to the following engagement processes for the above activities:

1. Electricity North West will first provide Electricity Suppliers, whose customers have been chosen to participate in the Project, with a Communications Plan advising them of the nature of the trial, and details of the timing and nature of communications with the customers affected.
2. Electricity North West will communicate with potential Demand Side Response customers explaining that the nature of the trial is to manage the distribution network using Demand Side Response for the benefit of customers and the network, and explaining that;
    - Remote control, monitoring and communications equipment will be installed at customers' premises that will allow Electricity North West to manage remotely the customer equipment;
    - Customer agreement to take part in the C_2C Project is required in order to gain access to their premises to install (and, if necessary decommission) the equipment;
    - No information will be used for marketing purposes;
    - Electricity North West will provide a telephone contact point for customers to make further enquiries;
    - Electricity North West will record the customer's agreement / refusal.
3. Where a Project Partner contacts a customer directly, Electricity North West will ensure that the Project Partner follows the requirements in this statement.

Electricity North West will make all information about the Project available in English and in alternative formats such as audio CD, Braille or minority languages on request.

APPENDIX 6b.1. OVERVIEW OF PROCESS FOR PROVISION OF THE STANDARD AND C2C CONNECTION OFFERS

The flowchart below details how Electricity North West will manage the provision of connection offers for identified new connections applicants within the C_2C Project.



Note, GSoP means Guaranteed Standard of Performance.

New connections applicants that request a Maximum Power Requirement of 100kVA and above and which requires reinforcement to connect to the distribution network will receive;

1. A standard connection offer which will be provided within the Standard Licence Condition 15 timescales; and
2. A C_2C connection offer, which will endeavour to provide in the provided within the Standard Licence Condition 15 timescales.

Electricity North West will contact the customer after sending out the C_2C connection offer to allow the customer to ask any questions on both connection offers.

APPENDIX 6b.2. C_2C PROJECT INFORMATION IN STANDARD CONNECTION OFFER

The standard connection offer will include briefing materials on the C_2C Project. The wording is still to be finalised but Electricity North West except to provide the following information:

- Background to the Low Carbon Networks Fund Capacity to Customers Project;
- Details on the involvement in Capacity to Customers Project;
- Benefits to customer, Electricity North West and society; and
- Next steps and confirmation it is an 'opt in' only scheme.

APPENDIX 6b.3. C_2C CONNECTION OFFER AND CONNECTION AGREEMENT

The wording is still to be finalised but Electricity North West expect to provide the following information in the connection offer:

- Background to the Low Carbon Networks Fund Capacity to Customers Project;
    - Confirm trial is for 3 years;
    - Describe the process for interrupting the supply and notifications;
    - Define the meaning of managed capacity;
    - Confirm change to connection charges but no change to DUoS charges;
    - List of contacts for Company and Customer.

- Details on the involvement in Capacity to Customers Project;
    - Conditions to be met by customers ie manageable capacity, site surveys etc
    - Statement to confirm that the connection will still comply statutory requirements.
    - The MIC and MEC of the connection plus the managed/ restorable capacity ie RIC & REC which is the reduced capacity level that can be restored.

- Benefits to customer, Electricity North West and society;

- Next steps and confirmation it is an 'opt in' only scheme.

The wording is still to be finalised but Electricity North West expect to provide the following information within an amended Connection Agreement:

- Definition of managed capacity;
- Details of the managed system components;
- Site responsibility schedule (generic equipment);
- Terms and Conditions covering managed contracts;
- Contact list for Electricity North West and Customer.

APPENDIX 6c. GENERIC CUSTOMER FEEDBACK FORM

Capacity to Customer (C_2C) Project
Customer Feedback Form

We are interested to hear your views on the experience of the Capacity to Customers Project. A number of Customer Feedback forms will be developed over the course of the Project to obtain feedback from customers involved in the various aspects of the C_2C Project. The areas where Electricity North West expects to engage with customers are highlighted below. The specific questions will be developed, as required.

Questions for customers involved in marketing of C_2C Project				
Questions for customer involved in Customer Segmentation Program				
Questions for New Connection Applicants				
Questions for customers affected by Planned Supply Interruptions				
Questions for customers involved in Demand Side Response Program				
Questions for customers affected by Unplanned Supply Interruptions				
Overall Customer Experience				
	Excellent	**Good**	**Fair**	**Poor**
Helpfulness of Electricity North West staff				
Usefulness of information				
General Comments				

You can e-mail the feedback form to us at: futurenetworks@enwl.co.uk or write to us at: C_2C Project Team Electricity North West Ltd. 304 Bridgewater Place Birchwood Park Warrington WA3 6XG	Your contact details: Name: Address: Tel: e-mail:

Appendix 7: PB Case Study Descriptions

In order to assess the financial benefit of the C_2C Method PB have conducted a series of desktop case studies comparing the C_2C Method to traditional reinforcement. These were conducted on projects that were requested in 2010 and the details of each can be seen below can be seen below:

Macclesfield

The capacity of the circuit providing the alternative supply to a premises in Macclesfield is insufficient to accommodate the increase in demand in accordance with their recent application. The proposed traditional reinforcement solution is to overlay a section of the circuit out of South West Macclesfield Primary with approximately 3km of cable.

Office building, Salford

Existing alternative supplies are inadequate to accommodate a proposed increase in demand at building. Consequently, two new 0.85km cable circuits are proposed from Salford Quays primary to provide a new HV point of connection at building.

Irlam Primary Reinforcement

Irlam Primary currently runs above its firm capacity using careful operational management, however, applications for new load connections mean that this is no longer possible. The proposed reinforcement solution is to replace the existing transformers with two new 23MVA transformers and to install a 4.6km cable from Carrington BSP to one of the new transformers.

Cheetham Hill Primary

During times of peak load an outage of one of the transformers at Cheetham Hill Primary can result in the overload of the remaining in-service transformer. One of the existing 33/6.6kV transformers is already rated at 23MVA as it is a recent replacement installed due to the condition of its predecessor. The proposed reinforcement solution is to replace the other transformer with another 23MVA transformer and to replace 17 panels of 6.6kV switchgear with higher rated equipment.

Local Town Centre

A supermarket's circuit out of Town Centre Primary is overloaded under normal conditions. The proposed reinforcement solution is to install a new 2.4km feeder, to move several open points to transfer load in the area and to install remote control at 4 locations.

Cog Lane Primary

Four circuits fed from Cog Lane Primary and Burnely GSP Primary have been identified as having overloaded alternative supply circuits during a worst case fault, which cannot be eliminated by switching. Part of the proposed reinforcement solution is to lay 1.7km of 6.6kV cable from Cog Lane Primary to tee onto an existing circuit and rearrange existing normally open points to provide additional backfeed capacity.

Further Education Institute

The existing supply circuit from Ormskirk Primary is unable to accommodate the additional load requested in recent application. The proposed reinforcement solution is to install 0.85km of cable from the primary substation to connect onto an existing circuit thus relieving the demand on the present supply circuit.

Copse Road

Three circuits fed from Copse Road have been identified as having capacity headroom and voltage problems under worst case fault conditions. The proposed reinforcement solution is to lay just over 1km of cable to overlay the small section cable in the first and second leg out of Copse Rd on the Siding Rd circuit.

Woodfield Road and Chorley South Primary

Four circuits fed from Woodfield Road Primary and Chorley South Primary have been identified as having limited capacity headroom and voltage drop problems on the related alternative supply circuits under worst case fault conditions. These problems cannot be eliminated by switching. The proposed reinforcement solution is to lay 1.2km of cable to provide interconnection between Buckshaw and Woodfield Rd primary substations.

Appendix 8: PPS Survey Results

Electricity North West Limited (Electricity North West) is preparing a bid to Ofgem as part of their Low Carbon Networks Fund. Electricity North West wishes to receive funding and regulatory approval for its Capacity to Customers (C_2C) Project. The C_2C Project involves a trial for participating businesses and developers to trade between lower connection charges (or some form of payment for an existing customer) and a low frequency risk of supply reduction following a network event causing a supply interruption.

The pilot will only be applicable to industrial and commercial customers, provisionally with a supply capacity of 100kVA and above. Electricity North West is interested, therefore, in identifying potential developments/development areas or projects that fall within enterprise zones; on land allocated for employment use; or existing business and industrial parks.
In order to identify areas/sites potentially suitable for the project, Electricity North West instructed PPS Group (PPS) to contact all Local Planning Authorities (LPAs) within Electricity North West's electricity distribution network area to ask for their help in identifying appropriate sites/areas. In particular, they felt that contacting planning departments and planning officers who would be able to provide the information they were seeking was important in terms of compiling the information they require in order to identify the best areas in which to carry out the pilot.

Engagement Process

The first task for PPS was to identify the relevant contacts at each of the LPAs identified by Electricity North West. We adopted a 'belt and braces' approach to contacting individuals at councils, with the focus on making contact with a relevant planning officer, executive member and director at each authority. The task was carried out largely through searches on council websites, phone calls to democratic services departments within councils and, where applicable, PPS used their existing knowledge of and relationships with officers, members and directors at particular authorities.

PPS wrote to each of the identified people on Electricity North West's behalf. Initially, this involved producing and sending letters, a Frequently Asked Questions (FAQ) document and a pro-forma aimed at planning officers with which to provide details of areas potentially suitable for the C_2C Project. Issue of these letters was followed up a week later with telephone calls to each of the recipient.

In order to ensure that the identified groups were targeted appropriately, PPS produced two letters for distribution. The first was targeted at planning officers, who Electricity North West felt were likely to be more receptive to the request and certainly the most likely to complete the information requested. The letter to planning officers provided information on the scheme and included a request for them to provide Electricity North West with information about potentially suitable areas for the C_2C Project, for which they were provided with a pro-forma to complete and return. A copy of the FAQ document was also sent to them.

The second letter was targeted at relevant executive members and directors who, although important, were seen as less significant in terms of receiving the information requested. Having said that, writing to these groups was important in terms of maintaining Electricity North West's reputation within its network distribution area as a matter of courtesy; and in recognition of the fact that relationships between councillors, directors and planning officers and the various responsibilities vary across authorities. Clear endorsement from a senior officer or member would facilitate a faster and comprehensive response from the planning department.

There are 34 authorities, largely but not wholly analogous with the standard North West of England region.

This second letter provided much the same information about the scheme, and also included the FAQ. It pointed out the benefits to the executive members and directors of complying with the request, the main message of which was that supporting the project would enhance an authority's reputation as a champion of business and regeneration and, whatever the outcome of the pilot, could only serve to benefit them.

Following the initial distribution of letters, PPS made follow up phone calls on behalf of Electricity North West to the planning officers, executive members and directors that had been contacted by post. Initially, these phone calls were used to identify whether letters had been received by the intended recipient and, if so, whether they had any queries about the letter, the request or the information provided. As they had been identified earlier on in the process as the most significant in terms of yielding a result, PPS began by contacting planning officers first. These calls were followed soon after by calls to executive members and directors, by which time, in a number of instances, PPS found that exchanges had taken place between planning departments, directorates and councillors.

A number of the initial calls confirmed that letters had been received and were being dealt with. As expected, several authorities explained that letters had been passed onto the most relevant person and who that was (a Director of Planning, for example, is likely to delegate tasks). PPS recorded any changes in the addressee in order to keep a record for Electricity North West of who their request was with.

In other instances, contacting executive members, directors and planning officers and letting each of them know in the initial letter who else had been contacted strengthened the process. For example, PPS spoke to one councillor who, aware that his Director of Planning and an officer in the department had received the request for information, was now arranging a meeting between the two to discuss the scheme and what information they may be able to provide. In PPS' experience, input from a number of individuals at the local authority is likely to lead to a more comprehensive response and an increased likelihood of a letter of support.

Summary of Engagement Results

This document provides a summary of the responses received to August 2nd 2011.
The response was notably better amongst planning officers than the executive members and directors that we contacted. There appear to be three main reasons for this differential. Firstly, because the follow up contact i.e. phone calls achieved a higher 'hit rate' amongst planning officers than members or directors. Secondly, as the local authority experts, planning officers are trusted to provide accurate and detailed information on request on a regular basis. Even when members and directors have confirmed that they have received their letters, because they have also been made aware that the planning department has also received correspondence from Electricity North West , they have taken this matter to be in the hands of that department and either delegated that work or worked collaboratively on it. The third is simply that planning officers were being asked for a factual response, carrying with it no impugnation of support, whereas the senior members/officers were being asked for some form of support, requiring greater consideration of the pros and cons; and perhaps consultation with colleagues.

Planning Officers: PPS wrote to 34 planning officers. In most cases the follow-up phone was to a more junior colleague who had been tasked by their head of department / team leader with responding to the request. To date, PPS and Electricity North West has received responses from nine LPAs with varying amounts of information. Planning officers from Bolton, Pendle, High Peak, Lancaster and Carlisle have sent in completed pro-formas. Holding replies have been received from West Lancashire and South Lakeland (including some information on the LDF from South Lakeland). St Helens Council has provided a wealth of information on existing employment areas, development sites and likely schemes including a written explanation and documentation. Whilst they have not completed a pro-forma, the information requested has been provided in alternative formats. From the conversations held, in many cases the letters acted as an introduction/ reminder as to who Electricity North West are, as well as to the C_2C Project itself.

The contact in Pendle dictated a number of sites over the phone rather than fill in the pro-forma, but reported that it sounded the sort of project that the council would be interested in. This attitude was supported by the subsequent comment from the member from planning when we contacted him.

Carlisle council were the only council to call PPS, unprompted by any follow-up call. They required a basic introduction to who Electricity North West were and the nature of the project before being able to discuss it, having never heard of the company. Despite undertaking to provide that information having had the discussion, nothing has been received to date.

Craven Council couldn't identify any sites that would be of use for the project, though indicated that at an in principle level they found it an interesting idea. PPS suspect that failure to identify sites is a combination of only a small proportion of Craven being in the Electricity North West area, and the area being very rural with significant national park overlaps. There will be few development sites of any magnitude throughout the entire district.

Executive Members and Directors: PPS wrote to 66 executive members and directors. To date, PPS has received two letters of support for the C_2C pilot project, from Sir Richard Leese, leader of Manchester Council and from Kim Webber, Director of Transformation for West Lancashire Council. Sir Richard's letter is the most significant endorsement the C_2C Project could have received, from the leader of the largest council in the project area and one of the longest serving leaders (over a decade) anywhere in the UK. It is also likely that Manchester will see a proportion of the project take place within its bounds, and is one of the most business intensive districts in the region so the significance of Sir Richard's support for the scheme is hard to exaggerate.

A key part of the proposed contact programme for the period January - March 2012 is to seek the endorsement and the awareness of figures such as Sir Richard so this support expressed now should be built on as soon as possible. Of the calls made to executive members and directors, a small number were of particular interest. At Pendle Council, PPS spoke to Leader of the Council and Economic Development portfolio holder, Mike Blomeley directly. Cllr Blomeley indicated that he had received the letter and was also aware that a similar letter had been sent to the authority's planning department. Cllr Blomeley was largely positive about the request and told PPS that he would be speaking to Pendle's planning manager so that they could put a response together. A response from Pendle Council has been received.

At South Lakeland Council, PPS spoke to Economic Prosperity and Transport Portfolio Holder Graham Vincent. Cllr Vincent was, again, positive about the request and indicated that, as was the case in Pendle, he would also be discussing the C_2C Project with colleagues. In this case the council's Economic Development team. Cllr Vincent explained that, although South Lakeland's Local Development Framework had yet to be finalised, he would be meeting with the Economic Development team shortly and they would be providing Electricity North West with the best information they could at this point.

At Wyre Council, Economic Portfolio Holder Cllr Barry Birch told much the same story. He explained that he would be looking at Electricity North West's request with the Economic Development Manager and that they would try to put something together.

At Burnley Council, PPS spoke to Martyn Hardacre in the Economic and Regeneration Development Unit. Mr Hardacre explained that the request had been sent to Winston Johnson as the most relevant person to complete the proforma, but also provided information over the phone and identified Burnley Knowledge Park as a potentially suitable area for the pilot. He explained that the site was adjacent to the new Burnley University campus and close to Junction 11 of the M65. Within the month of July, PPS wrote letters to all 34 local authorities, and made contact with at least one individual in 30 of 34 authorities over the phone.

The authorities that have so far responded are a mixture between unitary and district/borough councils and vary in size and party political composition and are at various stages of completion on their Core Strategies and Local Development Frameworks. The only common factor PPS can determine between theses authorities is that they have suffered in recent years due to a lack of inward investment. This would provide an explanation as to why these particular authorities have responded, as they may view the C_2C Project as an alternative means of attracting investment to their area. In the case of Bolton, its application to be awarded city status may also have played a part in their particularly detailed (see appendices) and prompt response.

As far as the request for letters of support is concerned, these have been less forthcoming, but with the inclusion of Manchester City Council's support, very significant.

This year's Second Tier LCNF project, Capacity to Customers (C_2C) aims to ascertain whether new and existing customers are able and willing to enter into a contract to deliver a demand/ generation side response (DSR/ GSR) following an unplanned interruption event.

Although similar in nature, the types of DSR/ GSR services that are expected to be provided by new and existing customers are different in the value proposition.. The contractual arrangements are similar to the existing 'interruptible' gas contracts but the main difference is that we will seek to procure DSR/ GSR from new and existing customers for the provision of 'delayed' restoration following a low frequency unplanned interruption event (ie in the event of a fault ENWL will require contracted customers to remain wholly or partially without supply for a defined period of time after other customers have been restored).

The contractual arrangements will also require the facility to call upon DSR/ GSR for scheduled outage management events, likely to be not required within the C_2C trial.

Issue

Delaying the restoration of supply to those newly contracted DSR/ GSR service providers will under the existing Interruption Incentive Scheme (IIS) rules result in Electricity North West incurring penalties.). As these customers have contractually accepted the delayed restoration following an unplanned interruption, the interruption to supply should be excluded from the IIS mechanism. A proposal for excluding the enactment of DSR/ GSR services is detailed below, by showing amendments to the guidance to the Quality of Supply RIGs.

Proposal - DSR/ GSR is not classed as an incident

The proposal is to exclude the interruptions of supply for DSR/ GSR services by amending the guidance on when an occurrence is not classed as an incident, and thus excluded in the scope of CIs and CMLs . The proposed changes are shown in red below:

Guidance - Incident

Occurrences that would not lead to an incident are as follows:

- maintenance outages and malfunctions of non-system equipment (eg pilot cables, etc) which do not result in the disconnection of a circuit or item of equipment energised at power system voltage, failures and overloads on customers‟ equipment or another connected system,
- which are cleared by the correct operation of the DNO's protection and which do not interrupt the supply to other customers of the DNO,
- pre-arranged works affecting customers for the purposes of meter changes, voltage standardisation and work on service cables and distributors' fuses, and
- contractually agreed interruptions to supply to a customer providing demand side or generation side response, and
- interruptions to supply resulting from load shedding in compliance with statutory and/or licence obligations following upstream incidents relating to either transmission or generation activities.

Appendix 10: Description of the methodology for the selection of HV and 33kV circuits to be included within the trial

Introduction

This Appendix describes the methodology that is proposed for the selection of 33kV and high voltage (HV) circuits to be included within the Capacity to Customers (C_2C) trial. HV circuits are defined as those circuits having a line-to-line voltage of 11kV or 6.6kV. The applicability of the approach to other distribution network operators (DNOs) has been considered in the development of this methodology.

The proposed methodology has been developed to allow the selection of representative samples covering different circuit types, voltage levels, customer types and circuit reliabilities. The circuits selected using this approach should cover the range of network constraints that would usually require the reinforcement of distribution networks using a traditional approach, and that the C_2C Project looks to mitigate. These constraints include thermal loading levels, voltage limits and fault levels. The proposed methodology also aims to capture the proactive and reactive nature of Electricity North West's management of their distribution system and customer connection applications.

It is assumed that the circuits selected for inclusion within the trial are being operated at present with a radial network topology. It is also assumed that the existing arrangement provides the power required to supply existing customers, and that suitable alternative supplies are available for compliance with the applicable security of supply standards (that is to say equipment is within its ratings).

It is proposed that circuits operate in a closed loop under the C_2C operating regime. In the event of a fault on the system it is anticipated that responsive loads and generation will be controlled as necessary (i.e. managed via commercial contracts) and the system will revert back to the traditional (i.e. radial) topology using automated switching.
Furthermore, it is assumed that both ends of the proposed closed circuit loop are supplied from the same primary substation and that primary substations are not being interconnected. It is also assumed that only one normally open (NO) point is closed, making a two ended loop, and NO points at connections to other circuits from the closed loop will remain open.

Description of circuit selection methodology

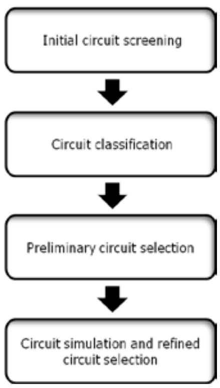
The circuit selection methodology is outlined below:

Step 1: Initial circuit screening;

Step 2: Circuit classification;

Step 3: Preliminary circuit selection;

Step 4: Circuit simulation and refined circuit selection.



Step 1: Initial circuit screening

Considering the full portfolio of approximately 3000 HV circuits within the Electricity North West network, it is first necessary to eliminate the circuits that are not considered likely to provide the opportunities for C_2C customer contracts or which are not currently technically viable for Project trials. The circuits to be considered for the trial will initially be narrowed down by identifying primary substations where:

- **a significant number of connection contracts have been offered recently.** Known developer activity and other regional demand growth will be taken into consideration. Electricity North West will also attempt to promote C_2C connections and liaise with local authorities.

- **the existing margin in circuit capacity is low,** meaning that reinforcement could be required for even a small connection. Circuit loading results calculated as part of a recent regulatory review could be used to rank circuits according to their load index (LI) and the highest-ranking circuits selected for trials.

The following criteria will be used as a basis for the elimination of unsuitable circuits fed from the selected primaries:

- Avoiding closed loops with sensitive / protected customers connected (i.e. hospitals);
- Avoiding primary substations with circuit breakers known to have slow/non opening problems;
- Avoid circuits fed from primaries which are run split owing to extant fault level constraints preventing solid operation;
- Avoid circuits containing customers with 'firm' connections that prevent closed ring running.

Step 2: Circuit classification
Circuits will be classified according to the following criteria:
Voltage levels;
Circuit types;
Customer types;
Circuit reliability.

Voltage levels
It is proposed that the following voltage levels are considered in the circuit selection methodology, in order to maximise the learning outcomes and applicability to other UK distribution networks:
33kV;
11kV;
6.6kV.

Circuit types
It is proposed that an appropriate mix of both overhead line and cable circuit types are included in the trial, in order to maximise the learning outcomes and applicability to other UK distribution networks.
The circuits leading from primary substations with 630A circuit breakers (CBs) could be of particular interest, as these have significant potential to provide capacity to customers without requiring an increase in the rating of the circuit breakers.

It is proposed that the following categories of circuit type are considered in the circuit selection methodology, based on the number of connected customers (as defined by Ofgem – see Table 2):
Very urban (UG);
Urban (MA);
Semi-rural (MB);
Rural (MC);
Very rural (OH).

Customer type
Existing customers may be categorised as:

- Generation connections;
- Domestic load demand connections;
- Commercial load demand connections;
- Industrial load demand connections.

In each of the above categories, customers may be further categorized, according to their sensitivity to the loss of supply. Circuits to which sensitive customers are connected (for example hospitals), should be identified and excluded from the trial.

The type of new customers may be categorised as:

- A generation connection (to which the network operator must react);
- A load demand connection (to which the network operator must react);
- Predicted load growth (which is anticipated by the network operator).

The connections department of ENW will be able to identify areas of network with significant connections activity (and anticipated significant connections activity) so that development 'hotspots' may be targeted. The C_2C Project offers benefits to HV-connected customers with a three-phase supply in excess of 60kVA, in that the cost of associated deep network reinforcements could be avoided.

Circuit reliability

The reliability of circuits may be assessed by quantifying the fault rate (the number and duration of fault occurrences within a certain timeframe). The fault rate of Electricity North WestHV overhead line and electric cable assets will be quantified during the application of the methodology and circuits will be selected to represent an appropriate spectrum of circuit reliabilities. It should be noted that the application of C_2C is anticipated to be on those circuits with a better than average overall level of reliability. Additional automation points will be installed on all selected circuits to ensure that connected customers are not adversely affected by the trial.

Step 3: Preliminary circuit selection

Following the classification of the circuits, a preliminary circuit selection will be made in order to obtain a representative set of circuits for the Project trials.
A number of statistical methods may be employed to select the circuits within each category.

Step 4: Circuit simulation and refined selection

The set of preliminary circuits will be simulated to identify any power flow, voltage or fault level issues that may arise as a result of operating two radial feeders as a closed loop.
The historic evolution of parts of the Electricity North West distribution system, as well as previous design policies based on economic considerations and the number of customers requiring supply, means that some radial HV circuits may be tapered from the primary substation to the present normally open points, or may have sections of smaller capacity anywhere along the circuit. The change to the network topology (and thus the change to impedance paths in the network) that result from the operation of the distribution network in closed loops could lead to the re-distribution of power flows.

Power flow studies of the selected closed loop circuits will be required to identify those sections of the closed loop circuit that may become overloaded as a result of the network topology change from radial to closed loop.

Load indices (LIs) and feedback from control engineers will be used to identify known hotspots (areas of thermal vulnerability) within the HV network. In addition, previous work carried out by Electricity North West provided a comprehensive analysis of all the HV circuits that are nearing full capacity for system normal and first circuit outage (n-1) situations. A partial revision of this study may be required to ensure that the most appropriate data and loading levels are used for the circuit selection analysis.

If it is identified that a significant length of circuit becomes overloaded when operated as a ring then the circuit will not be included in the trial. However, it is anticipated that limited levels of network reinforcement may be undertaken as part of the trial in order to make otherwise appropriate circuits 'trial-ready'.

Closing radial feeders to create a closed loop is likely to increase fault levels slightly, which may be problematic in the rare locations where fault levels are already close to equipment ratings, and particularly undesirable for the connection of new generation customers in urban networks when fault level margin is limited.
The following protection issues have been identified, which could influence circuit selection:

- The lockout, as a result of sensitive earth faults (SEFs), could prevent the protection system re-closing on overhead line sections;
- There is potential for a closed circuit to occur between dead and live sections at a primary due to busbar blocking schemes;
- There are possible problems with feeding overhead lines from both ends due to the potential for non-operation of protection schemes.

This more detailed assessment may lead to a number of iterations in the circuit selection process as circuits are selected and subsequently eliminated.
For other DNOs, the historic network evolution and the inherent network limitations could be different and the proposed selection methodology may need refining.

Circuit selection sample size quantification

The number of circuits proposed to make a credible representation of the network (and therefore generate meaningful results for transfer to other DNOs) is given in Table1.

Table 1 – Circuit selection sample size quantification

Selection criteria	Category breakdown	Category size
Voltage	• 11kV • 6.6kV	2
Circuit type	• Very urban • Urban • Semi-rural • Rural • Very rural	5
Reliability	• Low • High	2
Customer type	• Load connection • Generation connection • Both	3
	Total combinations:	60
	****Total number of circuits:**	**180**

**For meaningful results (to avoid anomalies) at least three circuits should be selected in each category. More circuits may be selected in some of the categories to ensure the collection of accurate trial results. Particularly accurate trial results may be required for a certain category because it is considered to be of the type, for which C_2C offers the most benefit, or because there are more of this type of circuit or because new connections of this type occur more frequently. However, there should be flexibility in terms of the number of circuits selected and contained within each category. This is because the majority of the circuits will be selected as a result of proactive capacity release, however, provision should be made for those customer connections (generation and /or load) that have the potential to demonstrate the Project benefits and for which the application is received during the course of the trial.

Appendix 10: Description of the methodology for the selection of HV and 33kV circuits to be included within the trial Cont...

Table 2 – Rural/Urban Classification Table

Ofgem IIS Band	Percentage of Overhead Line (in range)		Circuit Length in km (in range)		Number of Connected Customers	Number of Electricity North West HV Circuits in Band	Number of Customers in Band (% of Total)	Classification
UG1A	0%	0%	0	4	<1000	1438	18.0	Very Urban
UG1B	0%	0%	0	4	>1000	288	18.7	Very Urban
UG2A	0%	0%	>4		<2000	405	18.7	Very Urban
UG2B	0%	0%	>4		>2000	117	13.1	Very Urban
MA1A	0%	20%	0	8	<1000	63	1.2	Urban
MA1B	0%	20%	0	8	>1000	58	4.1	Urban
MA2A	0%	20%	>8		<2500	43	2.7	Urban
MA2B	0%	20%	>8		>2500	22	3.2	Urban
MB1A	20%	50%	0	11	<1000	66	1.4	Semi-Rural
MB1B	20%	50%	0	11	>1000	41	2.9	Semi-Rural
MB2A	20%	50%	>11		<2200	61	3.1	Semi-Rural
MB2B	20%	50%	>11		>2200	16	1.8	Semi-Rural
MC1A	50%	80%	0	19	<500	39	0.3	Rural
MC1B	50%	80%	0	19	>500	58	2.8	Rural
MC2A	50%	80%	>19		<1700	56	2.3	Rural
MC2B	50%	80%	>19		>1700	29	3.0	Rural
OH1A	100%	100%	0	40	<400	48	0.3	Very Rural
OH1B	100%	100%	0	40	>400	32	1.1	Very Rural
OH2A	100%	100%	>40	55	<700	16	0.3%	Very Rural
OH2B	100%	100%	>40	55	>700	6	0.4%	Very Rural
OH3A	100%	100%	>55		<700	6	0.2%	Very Rural
OH3B	100%	100%	>55		>700	8	0.3%	Very Rural

[1] 2,359,391 connected customer as of 2010/11

This methodology was developed by Dr Rita Shaw at Electricity North West, with contributions from colleagues at Electricity North West and other Project Partners. Dr John Broderick at the Tyndall Centre (University of Manchester) has reviewed this methodology and the overall carbon impact described, and considers that they are suitable for providing an indicative pre-Trial view of the carbon impacts of the C_2C Method.

1. Inclusions in scope of assessment

The carbon assessment indicates the expected difference in carbon impacts based on releasing network capacity by the Method being trialled in the C_2C project versus the most efficient methods currently in use. This assessment supports an explanation of how the C_2C project 'Accelerates the development of a low carbon energy sector' (specific requirement set 2a in the LCN Fund Governance Document v.4).

We have identified the three key carbon impacts of the project as

1. Facilitated emissions reductions by customers due to quicker release of network capacity (based on differences in emissions associated with transport, heating and electricity generation when these are facilitated by the distribution networks compared to the current alternative).
2. Asset carbon (based on differences in emissions embodied in assets installed, plus emissions associated with their transport to site),
3. Losses carbon (based on differences in distribution losses per year at a specified grid carbon intensity and level of network loading)

The last two elements relate to the distribution network's carbon emissions However beyond the changes in network emissions, the key driver for the C_2C Method is that it is expected to release network capacity more quickly and cost-effectively than the most efficient method currently in use. This is expected to allow customers to develop low-carbon generation and load projects (renewable, electric vehicles, heat pumps) without the cost and delays caused by a need for traditional asset-based reinforcement of high voltage distribution networks. So an estimate of these facilitated emissions reductions are also made, although they are not attributed solely to the distribution networks. Because of their differing natures, any impacts on network emissions (assets and losses) are presented separately from impacts on facilitated emissions.

All types of greenhouse gas emissions are considered rather than just carbon (dioxide). Thus the results are expressed in tCO_2e rather than tCO_2 or tC. However for clarity, the terms greenhouse gas (GHG), carbon and carbon dioxide are used interchangeably. Emissions are compared to 2010 UK per capita carbon emissions (9.4 tCO_2e) or to the 2020 EU ETS traded sector carbon emissions budget (197 tCO_2e), rather than conversion to a monetary value.

It is important to note that not all of the difference in emissions between the baseline case and the implementation of the C_2C method will be realised as physical carbon savings in the short term. This is due to the nature of the EU ETS that regulates emissions from the UK electricity grid and is common to any project altering electricity demand, generation or losses (unless permits are cancelled at the same time as reductions are claimed). All fossil-fuelled grid-connected generation is restricted by the emissions caps set within each phase of the EU ETS. Any reduction in demand for grid electricity simply reduces the demand, and hence the price of permits and the ultimate pattern of their surrender. This caveat does not apply to the calculation of asset savings in the same way, unless they were manufactured entirely by entities regulated under the EU ETS (e.g. EU metal producers and factories operated on EU grid electricity).

2. Methodology for assessing carbon impact for the Full Submission

The assessment for the Full Submission is based on analysing ten 'traditional' reinforcement projects representative of different reasons for 11/6.6kV system reinforcement on the Electricity North West network, and how the C_2C approach could have been applied. As real reinforcement projects, we can be assured that the reinforcements are well developed, have considered all options, will be accurately costed and be considered good value for money i.e. most efficient method currently in operation and follows the 'minimum cost' principles. One of the projects involved a hypothetical application of C_2C to a generation project, since a recent applicable generation project was not available.

For both the traditional and C_2C approach, PB Power has analysed the ten projects to indicate:

- the capacity released in each case,
- the assets used,
- the difference in timescale between the traditional and C_2C approach
- the level of losses associated with the alteration in the network and the increase in the level of network loading (at current profile shapes).

Sections 4a and 4b of the full submission summarise how the results of the ten case studies are scaled up in representative ways to indicate the net carbon impacts of the Method at different geographic scales.

- The Trial (scaling from 10 studied rings to 180 rings),
- The whole Electricity North West HV network (scaling from 10 studied rings to 1,000 rings), and acknowledging that network capacity will be added and used progressively over time, rather than instantly),
- Great Britain (scaling based on HV network length from Electricity North West to all applicable network)

In practice, the ten chosen projects are not homogenous and cannot be immediately assumed to represent *future* reinforcement requirements. Engineering judgement has been applied to scale the ten cases investigated in a way which is representative of the Trial and the Electricity North West network. This uncertainty will be described and reflected by expressing the facilitated carbon impacts as a plausible range rather than a single value.

The methodology was implemented in a quantitative spreadsheet model of the carbon impacts and net benefits of the C2C Method versus traditional approaches, when implemented at the scale of the Trial, Electricity North West network and GB. Sections 5 and 6 show the results of the model.

2.1 Scale of capacity release and timescale of impacts

The initial ten cases studied by PB Power suggested capacity release from 50% utilisation of latent capacity at 3 MVA per 11 kV ring and 2 MVA per 6.6 kV ring. Based on 1,000 eligible rings and a split between application at 11 kV and 6.6 kV based on the population of feeders (33%:67%), this implies that C_2C could release 2.4 GW of HV feeder capacity on the Electricity North West network, in addition to the 6.8 GW which can be accommodated at current diversity levels. This is a 35% increase on current levels of firm HV network capacity or around 50% relative to maximum load last year (6.8 GVA and 5 GVA respectively, identified as sum over primary substations, from Electricity North West LTDS 2010/11).

The period to 2035 is estimated to be the approximate period over which C_2C could replace traditional HV reinforcement on a significant proportion of our network. After that time, increasing demand for network capacity would exceeds the latent capacity which C_2C can deliver, and further increases in capacity would need to be delivered by a combination of traditional reinforcement in combination with C_2C. The period to 2035 was chosen by comparing the expected capacity released by C_2C with scenarios for customers' requirements for increased network capacity over time.

2.2 Timescale of impacts

The losses carbon impact is calculated in tCO_2e by year, with the results summed for the duration of the Trial and as a total for the periods 2012-2035. The impacts at the scale of the Project, the Electricity North West network, and GB's distribution networks will generally be considered over the timescale of a full roll-out of the Method to 2035. This is based on closing the ring in Trial circuits at end of 2012, and closing rings in the rest Electricity North West network and GB three years later i.e. closing the rings at the end of 2015. The full increase in loading and generation is spread over the period to 2035.

We have identified a number of long-term scenarios for electrical *energy* demands including the DECC 2050 pathways analysis. In National Grid's lead energy scenario to 2050, it expects a 50% increase in energy demand by 2050. In DECC's seventeen scenarios for 2050, there are a range of increases in electrical energy demand by 2050. In the 'spread effort' scenario, there is a 110% increase i.e. more than double, with an increasing rate of growth after 2020. The Committee on Climate Change also suggests an increase in the rate of growth of energy demand after 2020.

However, these analyses do not specifically consider how the increases in energy demand translates into an increase in peak power demand, particularly at distribution network level i.e. the driver of network capacity requirements. On the timescale of the next ten years to 2025, Ofgem's Project Discovery suggests relatively modest if any increases in electrical energy demand, and in different scenarios that peak demand across GB could remain at around 61 GW or rise to 71 GW. There is no comment on distribution network impact within this. National Grid suggests that distribution network capacity would need to more than double by 2030 to address increasing household demand and embedded generation, and to double again by 2050. Strbac et al suggested that in the (unspecified) long-term, 100% unconstrained penetration of electric vehicles and heat pumps would increase peak network demand across GB from 61 GW to 117 GW i.e. almost double.

Based on this range of inputs, our assessment is that there will be increases in HV power flows due to factors such as the introduction of electric vehicles and heat pumps at low voltages. There will also be increased power flows due to generation exporting onto the HV networks. However, other factors will mitigate some of the net growth in power flows on the high voltage networks e.g. generation on the low voltage networks, and increased energy efficiency in the design and usage of lighting and appliances, including the adoption of LED lighting. Furthermore, smart technologies and customers will allow demand and generation to be shifted away from peak periods, at least partially. So we think it is plausible that the increase in power flows on our HV networks by 2050 will be less than double current levels, and that network utilisation will rise, so that the increase in HV network capacity requirements by 2050 will be in the range 50-100%.

Given this significant uncertainty out to 2050, we have considered the timescale over which the 35% increase in capacity from C_2C would meet largely reinforcement requirements (at least on those circuits where C_2C is applicable). Depending on factors such as the use of biomass versus electricity for heating and transport, C_2C could provide all the capacity requirements to 2050 or more conservatively only until around 2035 (see Figure A13.1 below). In practice, traditional reinforcement may be required in development areas where spare capacity from C_2C is exhausted more quickly. As a result, we put a conservative timescale on the duration for which C_2C can release space capacity.

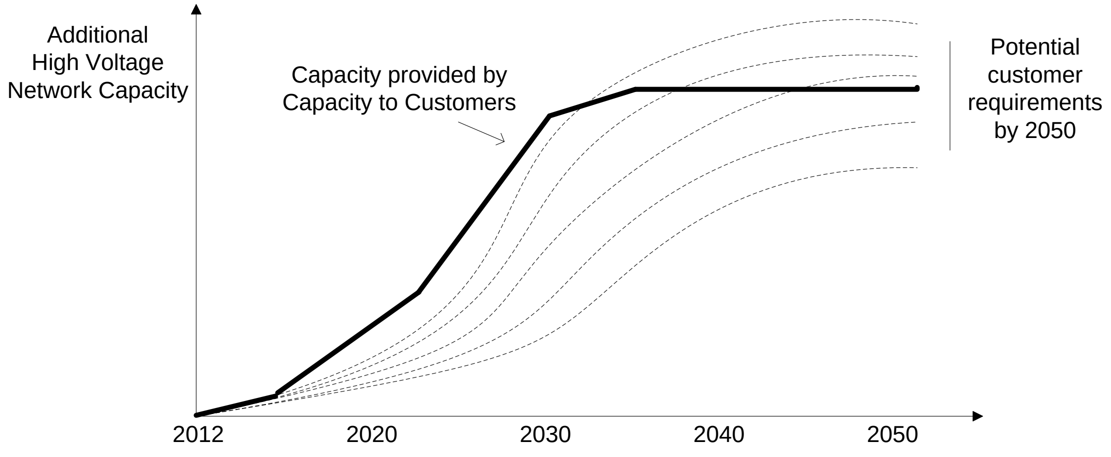


Figure A13.1 Scenarios for capacity provided and used over time

2.3 Assessing facilitated carbon impact

The Committee on Climate Change and DECC suggests significant increases in electricity demand on distribution networks and for renewable electricity generation connected to distribution networks. However heat pumps, electric vehicles and renewable generation are not the only potential sources of increased needs for HV network capacity, and DNOs do not control for what purposes their customers use their capacity.

To recognise this uncertainty, we consider specific examples of the three main reasons why a low-carbon economy would require increased HV network capacity. In each case the estimate of facilitated emissions reductions is equal to 4 months of reduced emissions by using the distribution network. This is based on avoiding a 4 month delay in increasing available network capacity. In each case the carbon intensity of grid electricity in 2020 as estimated in Figure 6.5/B6.13 of the Committee on Climate Change's 4th budget report (306 g/kWh).

1. New Electric Vehicles v. New conventional vehicles (not plug-in). The number of electric vehicles enabled is based on capacity released divided by 3kW (typical charge point rating), adjusted for losses between the LV and HV network (3%), power factor (~0.8) and diversity of vehicle charging (50% assumption in absence of long-term trial data). The carbon emissions are then compared based on a typical 8,000km/year/vehicle usage in a pure battery electric vehicle versus a conventional vehicle which cannot be plugged in, at the typical kWh/km and gCO2e/km rates for each vehicle type as indicated by the Committee on Climate Change's 4th budget report.

The difference in emissions is evaluated in 2020 since electric vehicles are at present just entering the mainstream vehicle market, but will need to be facilitated at MW scale by 2020. The comparison is made with new conventional vehicles in 2020, as a future impact on emissions is most fairly evaluated relative to the most credible future alternative vehicle which does not rely on the distribution network. The Committee on Climate Change suggests that new conventional vehicle emissions will reduce to 110 gCO2e/km to meet EU requirements (p157 of 4th budget report).

This suggests facilitated emissions reductions of 0.2 tCO2e/yr/kVA from capacity release for electric vehicles.

2. Domestic heat pumps v. Efficient gas boilers. The number of homes enabled for heat pumps is based on capacity released divided by 5kW (minimum peak rating in the National Energy Action 2010 report), adjusted for losses between the LV and HV network (3%), diversity of heat pump loads (75% assumption in absence of long-term trial data). The carbon emissions are based on additional electrical load of 5600 kWh/yr (~£700 at 12.5p/kWh) and the grid carbon intensity. This is compared to the carbon emissions associated with Ofgem's indicative medium domestic gas consumption of 16,500 kWh/yr, minus 10% to account for efficiency improvement and gas for cooking. This is combined with the natural gas tCO_2e/kWh rate from the 2010 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting.

The difference in carbon emissions is evaluated in 2020 since heat pumps are not currently being made available to the market at large scale now, but will need to be facilitated at MW scale by 2020.

This methodology suggests facilitated emissions reductions of 0.4 tCO2e/yr/kVA from capacity release for domestic heat pumps.

3. Renewable wind generation v. grid average carbon intensity in 2020. Taking the example of onshore wind at HV, the amount of electrical energy generation enabled per year is based on capacity released multiplied a 27% load factor over 8760 hours per year.

Although renewable generation can be connected at MW scale now, the difference in carbon emissions is evaluated in 2020, for consistency with the electric vehicle and heat pump benefits.

This methodology suggests facilitated emissions reductions of 0.7 tCO2e/yr/kVA from capacity release for onshore wind generation on the high-voltage network.

2.4 Assessing carbon impact from assets

In each case, specific assets are identified e.g. lengths of certain cable types, numbers of transformers. In 2007-08, Electricity North West undertook detailed analysis of the mass of different types of materials in the assets it was installing and distances/ vehicles/ fuels associated with transport to site in the year 2007-08. These were combined with established benchmarks at the time for the carbon impact of these materials and fuels. Together with operational emissions, this work was presented to Ofgem in July 2008 in a report on the company's carbon footprint. This work was done in advance of the regulatory requirement to provide such reports, and by including embodied carbon in assets was at a much more comprehensive level than Ofgem's current DCPR5 carbon footprint reporting requirements.

For the carbon impact assessment for C_2C, the 2008 work was updated for the carbon benchmarks of materials and fuels e.g. tCO_2e/kg, but without reviewing the assumptions for mass of materials or distance travelled. The latest carbon benchmark data were taken from the 2010 Guidelines to DEFRA / DECC's GHG Conversion Factors for Company Reporting, or from the University of Bath / BSRIA Inventory of Carbon and Energy (ICE) v2.0 (January 2011). In those cases where a material was missing from either of those datasets, the Environment Agency's carbon calculator for construction activities was used (v3.2.1), which is itself based on an earlier version of the ICE dataset.

Table A13.1 shows emissions associated with adding 1km of HV cable, covering both embodied and transport emissions. Emissions associated with installation labour form part of the DNO's overall carbon footprint, but could not be robustly associated with specific asset types, and have not been included here.

Table A13.1 Basis of asset-related emissions for high-voltage cable

Aluminium 300mm^2 Triplex (1km)		
Cable (embodied)	30.4	tCO_2e /km
Joints and terminations (embodied)	0.9	tCO_2e /km
Fill and tarmac (embodied)	10.1	tCO_2e /km
Cable, joints and terminations (transport)	1.4	tCO_2e /km
Fill and tarmac (transport)	0.6	tCO_2e /km
Excavation (transport)	1.2	tCO_2e /km
	44.7	tCO_2e /km

The carbon associated with the automation units to be used in C_2C Project (actuator and remote terminal unit cab) was estimated specifically for this assessment, based on the mass, mix of copper versus steel and supplier location.

The available input data on transformers did not consider the embodied carbon impact of insulating oil. Since Electricity North West reprocesses around 95% of its transformer oil, the carbon impact is not likely to be significant. The error introduced by this omission is likely will make the traditional approach appear less carbon intensive that it is. So the asset carbon case for C2C would be even stronger than the results suggest. However this effect is likely to be minimal, since primary transformer change projects to release HV network capacity are only a small proportion of all projects.

For C_2C, carbon impacts are scaled up based on the asset carbon per ring in the studied cases. For the traditional case, asset carbon impacts are scaled up based on the asset carbon per MVA, up to the MVA released by the equivalent number of rings in C_2C.

2.5 Assessing carbon impact from losses

Initial reduction
The change in the operational arrangement from radial feeders to closed rings can potentially bring an immediate losses reduction during the Trial (see A in figure 13A.2 below). The scale of this reduction will depend on the initial distribution of load across the network, and whether the existing position of the normal open point has been optimised to minimise losses or to minimise restoration times.

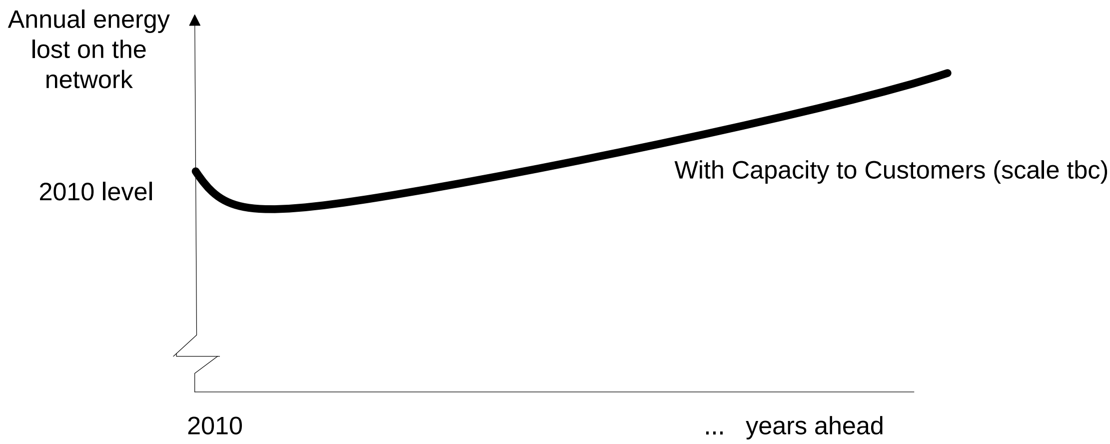
PB has quantified this difference in average losses in MWh/year for the ten projects, at the current loading level and profile, for open and closed rings. The calculation is based on the load factor, loss load factor, peak demand and a simulation of losses at peak.

The total scale of losses reduction was estimated for the Project, and compared to the annual MWh/year losses reported by Electricity North West to Ofgem. The full initial reduction is assumed in the year after a ring is closed.

Ongoing trend
As load is increased, whether the capacity is delivered traditionally or by C_2C, losses will increase (see B generically in figure 13A.2 below; section 4a of the full submission shows the calculated values). PB Power has evaluated the losses for the ten projects at a new higher loading, for the alternatives of C_2C and for traditional reinforcement involving larger assets of lower resistance. Future losses impacts are scaled up based on the losses performance of the studied cases.

No change in load factor or profile shape has been assumed at the higher loading level, but this assumption will need to be revisited in the carbon assessment work during the main Project.

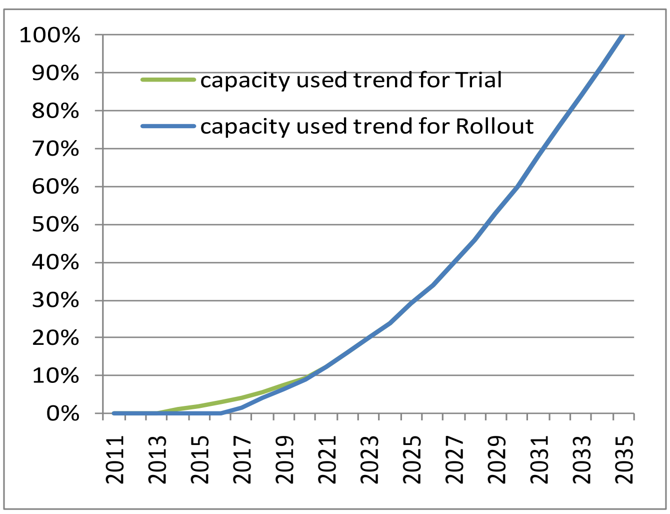
Figure 13A.2 Generic trend in annual energy losses over time



The trend in losses increase is expected to increase over time at an increasing rate as shown in figure 13A.3 below – both as capacity is progressively used (reflecting acceleration after 2020) and to reflect the physical relationship that losses increase as the square of current. The rate of increase in losses over time will be reviewed during the Project.

This same loading curve is used to estimate the losses impact occurring within the three year period of the Project (January 2012 to December 2014).

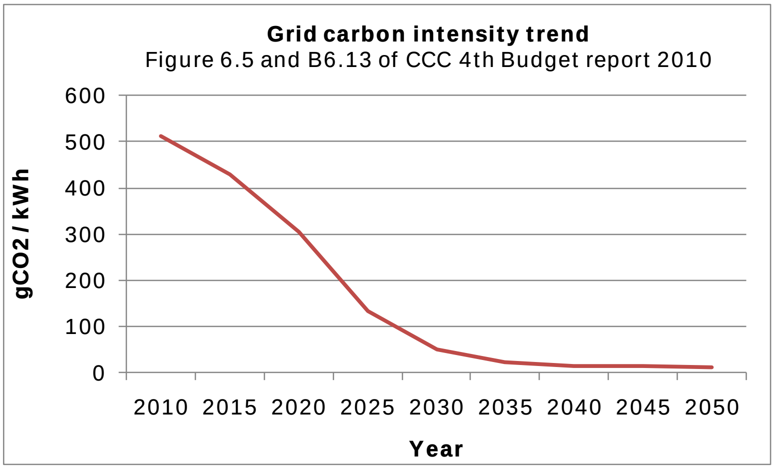
Figure 13A.3 Assumed trend in capacity used and losses increase over time



Carbon impact

In each year, the assumption for carbon emissions per MWh of losses comes from the grid carbon intensity trend in Figure 6.5 of the Committee on Climate Change's 4th budget report (2010), as shown below in figure 13A.4. Box 6.13 of the CCC's report indicates that the need to decarbonise the power sector is '*robust to a range of scenarios*' and the required trend does not significantly change, '*even if power sector technology costs are higher than expected or fossil fuel costs are lower*'.

Figure 13A.4 Committee on Climate Change's electricity decarbonisation assumptions



To find the total tCO_2e impact from losses to 2035, we combined losses in each year with tCO_2e/MWh in each year, and summed to 2035.

Scaling from case studies to the Trial, Electricity North West and GB
Informed by the case studies, our approach to estimating the difference in losses under C_2C and the traditional approach was based on a mix of projects being 'good', 'bad' and 'indifferent' from a losses perspective. These definitions depend on whether losses at higher loading are lower, higher or similar under C_2C and traditional reinforcement. In practice the difference in losses depends on network configuration, customer density and the extent to which reinforcement in the traditional approach will reduce feeder resistance.

In one of the case studies, losses increased very significantly when the ring was closed (+114 MWh/yr), due to a significant change in sharing of loads between circuits of different impedances. This case study was excluded from the rest of the analysis; at least for the Trial and at the current carbon intensity of losses, we do not intend to apply C_2C to circuits which would lead to such increases. This insight gained from the case study stage has led us to include losses performance in the circuit selection methodology.

The 'indifferent' category was associated with the rare projects involving primary transformer changes. Adjusting for the low incidence of such transformer projects, the spread of projects between the 'good', 'bad' and 'indifferent' categories was in the ratio 32%, 65% and 3% based on or the remaining case studies. This split of projects was applied when scaling up the losses results for the Trial, Electricity North West network and to GB. Given the wide range of losses behaviours, scaling from just nine case studies means the results are based on a relatively small sample.

At a 32% assumption for 'good' projects, the increase in losses carbon emissions does not outweigh the reduction in asset carbon emissions. The proportion of 'good' projects would have to fall to below 25% before the increase in losses carbon emissions outweighed the reduction in asset carbon emissions and led to an overall increase in the carbon impact of the network to 2035.

Exclusions from scope of assessment

Demand response in the C_2C Project is used to remove demand from the network at times of stress thereby maintaining the security of supply for customers. As such, it does not shift customer load from peaks, so we are not assuming any carbon impacts associated with switching to more or less more carbon intensive generation, or from reductions in losses at peaks.

We have identified various other potential impacts of C_2C on UK carbon emissions, which are difficult to directly associate and quantify relative to C_2C.

C_2C will offer financial incentives to customers to enter managed contracts. This will stimulate the overall demand response market, since these customers will also be introduced to other elements of the demand response market beyond C_2C. If demand response attracted by C_2C is able to contribute to national system margin, this may have a benefit of 300-750 tCO_2e/MW/yr. When there is a rare fault on their circuit, a C_2C customer would not be able to contribute to system margin, but they would be able to participate and deliver this value at all other times.

Changes in the carbon emissions associated with the operational activities of the distribution network e.g. fuel for depots/offices, fleets for installation, maintenance and fault fixing, substation electricity use. In Electricity North West's 2007-08 carbon assessment work, these total operational emissions were calculated but no attempt was made to subdivide these operational emissions between different asset types or activities. These emissions are difficult to associate with different types of asset and intervention on the electricity network, so we have not been able to present the marginal impact from the C_2C method on operational emissions. However this is not compared to be significant relative to the changes in emissions associated with assets and losses.

C_2C will allow renewable generation to access HV network capacity more quickly, assisting the decarbonisation of the power sector. For the specific generators connecting under C_2C, we include the difference between renewable electricity and the current grid carbon intensity as part of the facilitated emissions. However, we claim that C_2C will assist with the delivery of decarbonisation rather than reducing grid carbon intensity below the trend set out by the Committee on Climate Change (Figure 6.5, 4^{th} budget report).

After a fault, demand and generation connected under C_2C will have to constrain its load/output. Since faults are rare, possibly a few hours every few years, no correction will be made for this in the estimate of facilitated emissions reductions.

4. Development of carbon assessment during the Project

During the timescale of the Project, it will not be possible to demonstrate the full increase in network loading from demand and generation customers using C_2C. So during the Project, the focus of the carbon impact assessment work will be to learn from the Trial to review and update this initial assessment for a future roll-out of the Method, rather than to validate any specific numbers. For example, compared to scaling from representative mix of 10 projects identified before the Trial, information gained in the Project will allow a more accurate reflection of the mix of circuits, assets used and capacity released during the Trial.

The Tyndall Centre at the University of Manchester will review the *methodology* for carbon assessment, updating as appropriate to incorporate more recent carbon benchmarks, best practice in carbon assessment, and scenarios for the rate of decarbonisation in the UK. This may involve assessing carbon impacts via the framework defined by the World Resources Institute's GHG Protocol for Project Accounting.

The Tyndall Centre will assess the C_2C method's net impact on both *network* carbon emissions, and the *facilitated* emissions reductions. The impact on network emissions will use data inputs from installations in the Project, from Electricity North West's annual carbon footprint reporting, and from modelling of losses/loading level and profile / capacity released by the Universities of Manchester and Strathclyde. The impacts on facilitated emissions will use data inputs related to the scale and type of capacity released by C_2C, and latest information and scenarios for customers' network capacity requirements.

Both these assessments will be done at the scale of the Trial and also extrapolated to full roll-outs across the Electricity North West HV network and across GB, identifying how these carbon impacts might change over time. The results of the analysis will be communicated as described in the dissemination plan.

5. Summary of carbon impacts

In the following tables taken from our spreadsheet model of carbon impacts, the first row of each section refers to impacts at the scale of the Trial (180 rings) and the final row at the scale of the Electricity North West network (1000 rings). The impacts at GB are based on scaling up the results for the Electricity North West network by a factor of 13.74.

After establishing the number of rings and MVA released at each voltage level, the tables detail the changes in losses (in MWh) to 2035, from the current baseline. The green sections show network carbon impacts in the C_2C and traditional cases (additional assets and changes in losses) while the blue section shows facilitated carbon impacts. The facilitated impacts reflect four months of emissions from different types of low-carbon customers. The final lines of the facilitated carbon impacts reflecting a potential mix of capacity used by electric vehicles, heat pumps and wind generation (30%, 20% and 40% respectively, with remaining 10% of capacity reflecting growth in customer numbers).

Appendix 11: Carbon Savings and Calculation Methodology Cont...

Impacts at scale of Trial and Electricity North West

	No. of rings			MVA released on HV network		
	11kV	6.6kV	Total	11kV	6.6kV	Total
Trial	90	90	180	271	183	454
ENWL network	330	670	1000	995	1,362	2,357

	Change in losses to 2035 (MWh)		
	C2C	Traditional	*Change*
Trial	197,000	84,000	113,000
Rest of ENWL network	896,000	385,000	511,000
Total ENWL	1,093,000	469,000	624,000

	Asset carbon change			Losses carbon change to 2035			Net network carbon to 2035
in tCO2e	C2C	Traditional	*Change*	C2C	Traditional	*Change*	*Change*
Trial	500	8,700	*-8,200*	11,000	6,800	*4,200*	***-4,000***
Total ENWL network	2,800	49,100	*-46,300*	67,400	35,600	*31,800*	***-14,500***
= no. of UK citizens in 2010	C2C	Traditional	*Change*	C2C	Traditional	*Change*	*Change*
Trial	100	900	*-900*	1,200	700	*500*	***-400***
Total ENWL network	300	5,200	*-4,900*	7,200	3,800	3,400	***-1,500***

Options	4 months of claimed facilitated emissions changes		
in tCO2e	Elec. Vehicles	Heat pumps	Windfarms
Trial	-38,000	-64,000	-109,000
Total ENWL network	-190,000	-330,000	-570,000
= no. of UK citizens in 2010	Elec. Vehicles	Heat pumps	Windfarms
Trial	-4,000	-7,000	-12,000
Electricity North West network	-20,000	-40,000	-60,000
Units enabled options	Elec. Vehicles	Heat pumps	Windfarms
Trial	877,491	1,754,982	227
Electricity North West network	4,552,062	9,104,124	1,179
	3kW EV	5kW HP	2 MW wind turbines

Units enabled in combination	30%	20%	40%	
MVA	707	471	943	
in tCO2e	-57,000	-66,000	-228,000	-350,000
= no. of UK citizens in 2010	-6,000	-8,000	-24,000	-38,000
	1,365,619	1,820,825	471	
	3kW EV	5kW HP	2 MW wind turbines	

Impacts at scale of Great Britain

	No. of rings	MVA
GB	13,740	32,400

	Change in losses to 2035 (MWh)		
	C2C	Traditional	*Change*
GB	15,018,036	6,444,153	8,573,883

	Asset carbon			Losses carbon to 2035			Net network carbon to 2035
	C2C	Traditional	*Change*	C2C	Traditional	*Change*	*Change*
in tCO2e	38,000	675,000	*-637,000*	942,000	482,000	*460,000*	***-177,000***
= no. of UK citizens in 2010	4,100	72,200	*-68,100*	101,000	52,000	*49,000*	***-19,100***

Options	4 months of claimed facilitated emissions reductions		
	Elec. Vehicles	Heat pumps	Windfarms
in tCO2e	-2,600,000	-4,520,000	-7,809,000
= no. of UK citizens in 2010	-300,000	-500,000	-800,000
Units enabled options	Elec. Vehicles	Heat pumps	Windfarms
	62,572,500	125,145,000	16,200
	3kW EV	5kW HP	2 MW wind turbines

But this assumes the full GB MVA will be used for EVs or HPs or windfarms, actually a mixture
Hypothetical capacity mix of low carbon options, and 10% for growth in customer numbers

	30%	20%	40%	
MVA	9,720	6,480	12,960	
in tCO2e	-780,000	-904,000	-3,123,600	-4,810,000
= no. of UK citizens in 2010	-90,000	-100,000	-320,000	-510,000
	18,771,750	25,029,000	6,480	
	3kW EV	5kW HP	2 MW wind turbines	

An extract from the Consortium agreement which is 38 pages in length.

THIS AGREEMENT is dated 17 August 2011

Parties

- Electricity North West Limited incorporated and registered in England and Wales with company number 2366949 whose registered office is at 304 Bridgewater Place, Birchwood Park, Warrington, WA3 6XG ("ENWL").

- Parsons Brinckerhoff Ltd incorporated and registered in England and Wales with company number 2554514 whose registered office is Amber Court, William Armstrong Drive, Newcastle Business Park, Newcastle Upon Tyne, NE4 7YQ.

- Flexitricity Limited incorporated and registered in Scotland with company number SC263298 whose registered office is at Exchange Tower, 19 Canning Street, Edinburgh, EH3 8EG.

- Enernoc UK Limited incorporated and registered in England and Wales with company number 6937931 whose registered office is at Alder Castle, 4th floor, 10 Noble Street London, EC2V 7JX.

- Npower Limited incorporated and registered in England and Wales with company number 03653277 whose registered office is at Windmill Hill Business Park, Swindon, Wiltshire, SN5 6PB.

- National Grid Electricity Transmission Plc incorporated and registered in England and Wales with company number 2366977 whose registered office is at 1-3 Strand, London, WC2N 5EH.

- The University of Manchester (a Royal Charter corporation registered under number RC000797, an exempt charity) whose registered office is at Oxford Road, Manchester, M13 9PL;

- The University of Strathclyde incorporated by Royal Charter a charitable body registered in Scotland with registration number SC015263 and whose registered office is at 16 Richmond Street, Glasgow, G1 1XQ.

(each a "Party" and together the "Parties")

Background

- The Parties propose to trial the release of network capacity inherent in HV and EHV networks to reduce the need for disruptive and expensive traditional reinforcement. This will be achieved by applying existing automation techniques to pre selected circuits. In addition the Parties will explore and utilise innovative demand/ generation management arrangements to manage customer loads in times of a network fault in order to meet customers' needs for security of supply.

- The Parties intend to participate in the Project according to the Authority Submission, and the Project Plan.

Executed by

Duly authorised signatory for and on behalf of Electricity North West Limited

....

Director

Executed by

Duly authorised signatory for and on behalf of Parsons Brinckerhoff Ltd

KATHERINE JACKSON
OPERATIONS DIRECTOR, POWER SYSTEMS
PARSONS BRINCKERHOFF

Executed by

Duly authorised signatory for and on behalf of Flexitricity Limited

....

Alastair Martin
Director
Flexitricity Ltd 16/08/2011

Executed by

Duly authorised signatory for and on behalf of Enernoc UK Limited

....

Director

Executed by

Duly authorised signatory for and on behalf of Npower Limited

Executed by

Duly authorised signatory for and on behalf of National Grid Electricity Transmission Plc

....

MIKE CALVIOU
DIRECTOR OF ASSET MANAGEMENT.
16/8/11

Executed by

Duly authorised signatory for and on behalf of The University of Manchester

....

Director

Executed by

Duly authorised signatory for and on behalf of The University of Strathclyde

....

DR. D. G. MCBETH
DIRECTOR
RESEARCH & KNOWLEDGE EXCHANGE SERVICES

Director

Appendix 13: C_2C Event Sequence

<table>
<tr><th>Step</th><th>Action</th><th>Software</th><th>Comment</th></tr>
<tr><td>1</td><td>Local protection detects the presence of a fault and operates primary circuit breakers to clear the fault from the system – event alarms are received by Electricity North West's NMS via SCADA</td><td>SCADA/ Electricity North West's NMS</td><td>This represents no change from the current arrangements with all real-time analogues and event information passing to Electricity North West's NMS via SCADA etc</td></tr>
<tr><td>2</td><td>Electricity North West's NMS processes the alarms and classifies the fault (i.e. loss of supply/transformer fault etc)
In the event of a loss of supply following a fault on one of the HV rings then continue onto step 3.</td><td>Electricity North West's NMS</td><td>Again this represents no change from the current arrangements. A slight caveat is for the loss of a primary transformer feeding a closed ring.</td></tr>
<tr><td>3</td><td>Electricity North West's NMS issues an open command to the NOP to split the ring (restoring the configuration to two radial feeders and thus facilitating the operation of automation)</td><td>Electricity North West's NMS</td><td>It is important that the network is returned to a configuration such as to allow existing automation logic to run – thus the NOP must be opened as a first step</td></tr>
<tr><td>4</td><td>GE's Power-On Fusion software is queried by Electricity North West's NMS and a schedule of all relevant (i.e. those within the area of interest) interruptible loads/switches is received (and the KVA)</td><td>Power-On Fusion</td><td>It is expected that this will simply comprise a list of all controllable devices within the area of interest. In order to reduce complexity during the trial, any contracted (i.e. interruptible) load will be 'held-off' during the restoration attempt. These loads will be revisited later in order to determine how best they can be re-energised via the remaining assets/capacity</td></tr>
<tr><td>5</td><td>Electricity North West's NMS opens all interruptible loads/switches from the dead zone</td><td>Electricity North West's NMS</td><td>We would expect to have control over the relevant switching devices and circuit breakers</td></tr>
<tr><td colspan="4">At this stage we have essentially restored the network and loads to standard running. That is we have split the ring and now have two radial feeders either side of an NOP. In addition, the load on the network (albeit off supply) is within the rating of the installed assets. Given this, we can simply initiate an automation attempt.</td></tr>
<tr><td>6</td><td>GE's Power-On fusion software is again queried by Electricity North West's NMS this time to request the estimated loadings for all transformers in the dead zone</td><td>Power-On Fusion</td><td>This is the load allocation (or load flow) stage. Electricity North West's automation logic needs to know what loads will be restored and where (i.e. which nodes), in order to maximise the success of the restoration sequence. The load flow will run in the background every 5 minutes and the results made available to Electricity North West's NMS through the interface</td></tr>
<tr><td>7</td><td>Electricity North West's NMS initiates the automation restoration sequence logic in an attempt to restore lost supplies</td><td>Electricity North West's NMS</td><td>In reality one circuit will simply be re-energised. The other circuit (the one with the fault) will require the action of the automation logic to locate and bound the fault and restore all supplies outside of the faulty section from both source and all NOPs utilising load estimates on transformers
Electricity North West will need to enhance its existing automation logic to take better account of the load estimation values obtained during step 6. Electricity North West's ARS will where appropriate segment the network to maximise restoration outcomes.</td></tr>
<tr><td colspan="4">At this stage the automation logic has run; the faulty section has been bound (i.e. isolated) and the maximum amount of load outside of the faulty section of network has been restored from the source and adjacent networks. All interruptible load remains 'held-off' and the next stage in the process is determine how best to restore this load.</td></tr>
<tr><td>8</td><td>GE's Power-On Fusion software is requested to produce a schedule of switch operations which when actioned would result in the re-energisation of the interruptible load which is currently 'held-off'</td><td>Power-On Fusion</td><td>This is expected to comprise of a set of switching instructions passed to the control engineer to validate and action. At this stage no attempt will be made to automate this step – this will be deliverable upon establishing confidence that the outputs are valid. Any updates to the network will be reflected back into the Power-On Fusion software based upon an update of the whole model to run every 5 minutes.</td></tr>
<tr><td>9</td><td>GE's Power-On Fusion software will log all of the relevant information on the interrupted loads</td><td>Power-On Fusion</td><td>It is necessary to keep records of the use of the interrupted loads; such as the duration off-supply and the nature of the event</td></tr>
<tr><td colspan="4">In the event of a fault on one of the feeding transformers (i.e. primary transformer – EHV); Electricity North West's NMS will query the GE Power-On Fusion software for a list of all relevant interruptible loads (i.e. step 4) and then initiate steps 5 and 8 as per the above.</td></tr>
</table>

[1] *This methodology will limit the extent of pre-fault loading on the transformers to within the existing 3 minute rating for a transfer (i.e.< 150%). In future, there may be a need to push beyond this which will require corresponding code/logic changes to avoid tripping a transformer on overload during N-1.*

[2] *No intention to utilise interconnectors or to automate process this during the trial*