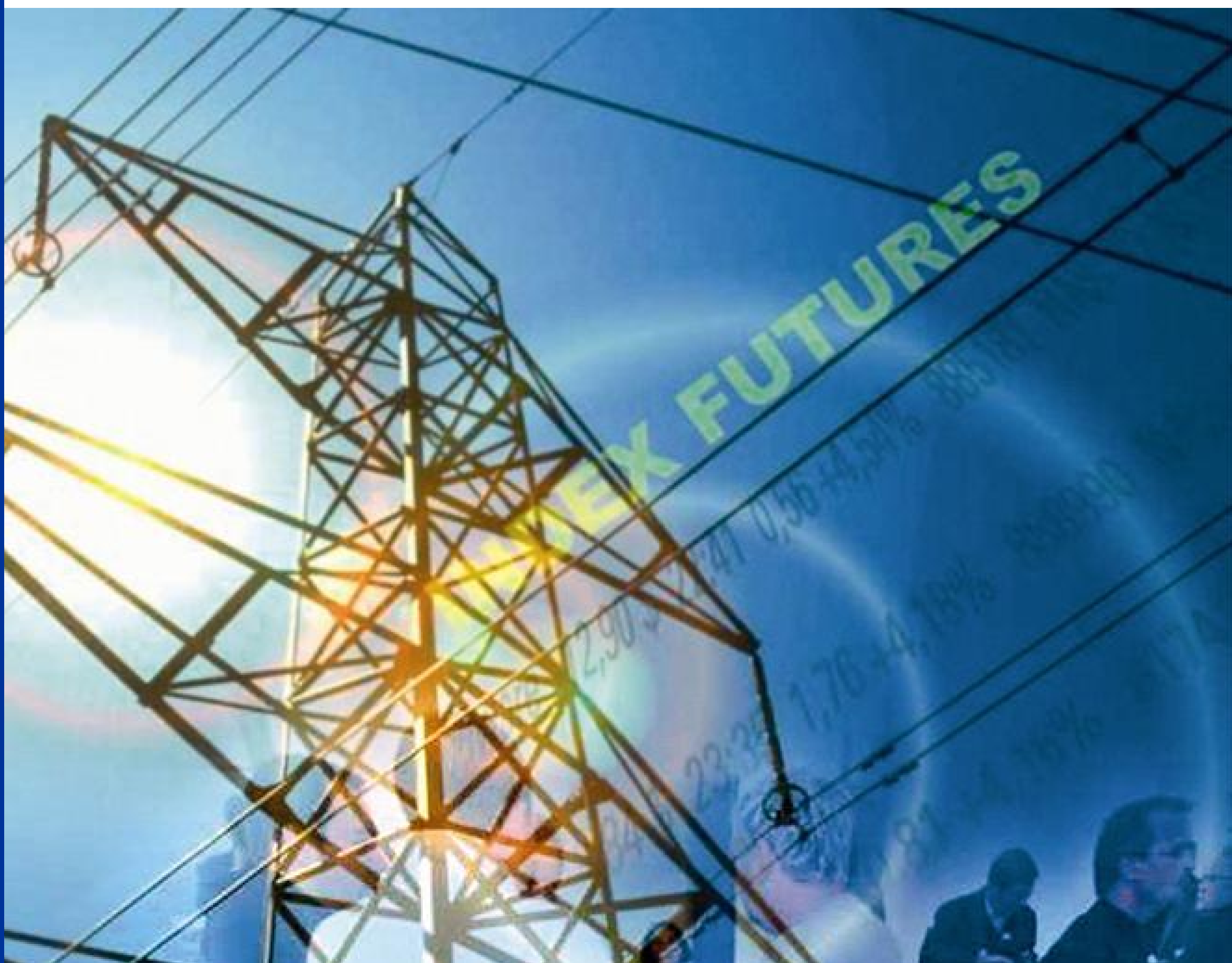
AN INDEPENDENT EVALUATION OF THE LCNF

A report to Ofgem

October 2016

EVALUATION OF THE LOW CARBON NETWORKS FUND



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EXECUTIVE SUMMARY

The Low Carbon Networks Fund (LCNF) has provided approximately £250m[1] of funding to projects sponsored by the six Distribution Network Operators (DNO) of Great Britain (GB) over the period 2010-2015. The original objective of the LCNF was to help all DNOs understand what needs to be done to provide security of supply whilst achieving value for money – as GB moves to a low carbon economy – and also what role the DNOs could play in facilitating low carbon and energy saving initiatives to tackle climate change. The LCNF aimed to help DNOs explore new technologies and to develop alternative operating regimes and commercial arrangements.

In April 2013 Ofgem introduced the Revenue = Incentives + Innovation + Outputs (RIIO) framework for the economic regulation of gas and electricity transmission companies and for gas distribution companies. The new framework embedded 'innovation' into price control regulation and Ofgem replaced the LCNF with a more comprehensive Network Innovation Stimulus package.

Overview of the LCNF

The LCNF was designed to meet the following objectives:

- incentivising the DNOs to include innovation as part of core business;
- helping the DNOs to move towards a low-carbon business whilst maintaining security of supply and delivering value for money to customers;
- helping the DNOs facilitate low-carbon and energy saving initiatives;
- dissemination of learning to facilitate roll-out of successful trials and subsequent network savings and or carbon benefits; and
- encouraging collaboration between the DNOs, and with third party project partners.

The aim of this evaluation project

The overarching aim of this evaluation is to understand the extent to which the aims of the LCNF have been met in supporting the future development of innovation in the industry.

A key part of this work has been to engage with those who have been involved in the LCNF, and also with those who have thoughts and views which have contributed to the evaluation process – including Ofgem, LCNF participants (DNO and non-DNO), academia, Government, councils, manufacturers, potential NIC participants and other industry regulators. This evaluation follows on from the study of 'LCNF learning' commissioned by Ofgem[2] which produced a summary of project learning and provides a view of the extent to which the DNOs have been successful in integrating LCNF projects

1 This is the approved funding by Ofgem and net of the contribution from DNO and project partners. It includes both Tier 1 and Tier 2 projects.

2 Summary of the Low Carbon Networks Fund learning, EA Technology, April 2016. (https://www.ofgem.gov.uk/publications-and-updates/ea-technology-s-summary-low-carbon-network-fund-learning).

into normal business practices. We have also drawn on some of the findings of a recent academic study on the outcome of the LCNF projects[3].

Conclusions

The key findings and conclusions associated with our evaluation of the LCNF are set out below. This considers performance against the LCNF objectives, integration into business as usual practices, and our independent view on the extent to which the LCNF has delivered value-for-money. Further detail on each of the concluding comments below can be found in Section 7 of this report:

- the LCNF has succeeded in encouraging DNOs to innovate and has served to move the level of innovation within the DNOs from a 'low' base to a 'moderate' level;
- LCNF has encouraged DNOs to include innovation as core business, with encouraging sign of transfer to business as usual – but this work is still progressing;
- current benefits are estimated to be approximately one third of the total funding cost;
- the potential future net-benefit from the LCNF projects is significant and is estimated to range from 4.5 to 6.5 times the cost of funding the scheme;
- projects which focus on the connection of distributed generation (DG) and flexible demand have a high potential value and are the most likely to be readily incorporated into current-day business practice; and
- there is insufficient high-level overview and co-ordination of individual projects to ensure alignment with the overall direction of the industry.

Recommendations

Our conclusions have led to the following recommendations. Further detail on each of the recommendations can be found in Section 7 of this report:

- Ofgem should continue to fund DNO innovation to ensure the culture of innovation continues to develop within the network businesses. Consideration should be given as to how support for DNO innovation can best accommodate the future requirements of the whole, low carbon, energy system;
- the DNOs should be required to jointly develop and publish an 'innovation roadmap'. This should be developed in conjunction with the System Operator, the transmission companies, other parties such as Independent Distribution Network Operators and participants associated with other energy vectors such as gas, heat networks and transport. Research funding bodies such as EPSRC, DBEI, Innovate UK and other relevant industry initiatives should also be included to ensure funded innovation is optimised to deliver maximum benefit for customers;
- there should be greater focus on the sharing of project knowledge and learning – particularly across and between the DNOs –in order to maximise the benefits and value of LCNF initiatives and innovation;

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3 University of Strathclyde. 'A Review and Synthesis of the Outcomes from Low Carbon Networks Fund Projects', September 2016 (http://www.ukerc.ac.uk/publications/a-review-and-synthesis-of-the-outcomes-from-low-carbon-networks-fund-projects.html).

- more focus should be placed on the learning which results from unsuccessful projects, or parts of projects;
- reporting requirements associated with any future innovation funding should be reviewed to facilitate the future assessment of quantitative benefits. Ongoing reporting should include project outcomes, learnings and also the progress associated with business as usual implementation of LCNF initiatives.
- Network Innovation Competition (NIC) participants should be encouraged to co-ordinate with relevant Government departments, and other institutions, to explore opportunities to share and exchange project learnings and experience with other sectors and with other countries and jurisdictions; and
- in the light of the findings of this evaluation, a number of specific changes to the governance arrangements associated with the electricity NIC should be made. Details of these are provided in Section 7.3 of this report.

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1. INTRODUCTION

This study has been commissioned by Ofgem to provide an independent evaluation of the Low Carbon Networks Fund (LCNF). The project has been undertaken by Pöyry Management Consulting (UK) Limited ("Pöyry") and Ricardo Energy and Environment ("Ricardo").

1.1 Background to the LCNF

The Low Carbon Networks Fund (LCNF) provided approximately £250m[4] of funding to projects sponsored by the six Distribution Network Operators (DNO) of Great Britain over the period 2010-2015. The original objective of the LCNF was to help all DNOs understand what needs to be done to provide security of supply whilst achieving value for money – as GB moves to a low carbon economy – and also what role the DNOs could play in facilitating low carbon and energy saving initiatives to tackle climate change. The LCNF aimed to help DNOs explore new technologies and to and develop alternative operating regimes and commercial arrangements.

Prior to the introduction of the LCNF, Ofgem were concerned that the price control mechanism was encouraging companies to seek short term cost savings to the exclusion of innovation research which needs a longer term for pay off. In establishing the LCNF Ofgem was aware of the challenges regulated businesses face in the area of innovation and aimed to replicate the incentives on unregulated companies to innovate. Innovative companies which compete in competitive, liberalised, markets usually stand to gain commercially from innovation. Businesses which are subject to economic regulation – such as the DNOs – have argued that they may incur the costs of innovation projects if they fail (as the cost may not be allowed by regulators). In addition they will not be able to fully capture the benefits of successful innovation as it will be fully or partially clawed back at subsequent price control reviews.

In April 2013 Ofgem introduced the Revenue = Incentives + Innovation + Outputs (RIIO) framework for the economic regulation of gas and electricity transmission companies and for gas distribution companies. The new framework embedded 'innovation' into price control regulation and Ofgem replaced the LCNF with a more comprehensive Innovation Stimulus package.

In the longer term Ofgem expects the incentives within the RIIO framework to encourage the DNOs to innovate as part of their normal business practices[5]. Until this happens it is likely that some form of innovation stimulus will need to continue to exist if the objectives of the LCNF remain.

1.2 Overview of the LCNF

The LCNF was designed to meet the following objectives:

- incentivising the DNOs to include innovation as part of their core business;
- helping the DNOs to move towards a low carbon business whilst maintaining security of supply and delivering value for money to customers;

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4 This is the approved funding by Ofgem and net of the contribution from DNO and project partners. It includes both Tier 1 and Tier 2 projects.

5 https://www.ofgem.gov.uk/ofgem-publications/84601/assessmentofinnovationstrategies.pdf

- helping the DNOs facilitate low carbon and energy saving initiatives;
- dissemination of learning to facilitate roll out of successful trials and subsequent network savings and or carbon benefits; and
- encouraging collaboration between the DNOs, and with third party project partners.

To achieve these objectives the LCNF was constructed with two distinct funding mechanisms. The first was to fund a proportion of expenditure incurred on the smaller-scale projects ('Tier 1' projects). The larger ('Tier 2') projects were provided with total funding of up to £320m (of the total £500m) over the five year period. Tier 2 was operated as an annual competition, in which bids were submitted to and decided upon by Ofgem. This Tier 2 funding focussed on a small number of larger, more significant, 'flagship' projects.

There were 23 Tier 2 projects, of which 11 had been completed by May 2016, eight were well underway and four commenced in 2015. In contrast there were 42 Tier 1 projects 31 are completed, 8 are ongoing[6] and one which was halted during the programme[7].

In addition, the 2010 LCNF governance document noted that the LCNF trials will be used to inform the business plans that the DNOs submit at the price control reviews.

1.3 Future Energy Scenarios

The 2010 LCNF governance document highlighted the challenges facing the DNOs associated with the change in use of distribution networks as the take up of distributed generation (DG), demand side management (DSM), electric space heating, electric vehicles and electricity storage increased. It was expected that this could require changes to the way the networks are designed and operated, and the commercial role the DNOs play. It was acknowledged that there was uncertainty over how quickly and to what extent the take-up of low carbon initiatives would happen and it was expected that advances in information and communications technology (ICT) and smart meter data could enable the DNOs to run the networks more efficiently and flexibly.

Over the last six years National Grid (NG) has developed future energy scenarios[8] (FES) with a focus on the adoption of DG, the uptake of electric vehicles (EV) and heat pumps (HP). The NG scenarios were first developed in 2011 to show a range of plausible and credible pathways for the future of energy to 2050 and due to the uncertainty surrounding the future they are continually developed and are revised annually. The NG FES took account of the Department of Energy & Climate Change (DECC[9]) carbon budgets and pathway predictions. During the LCNF period the initial success the government Feed In Tariff (FIT) incentives resulted in a more rapid take up of DG than predicted meaning the policy was revised adding uncertainty around the prediction of connection of DG.

The uncertainty and difficulties associated with predicting future load growth for both transport and heat are widely acknowledged. One illustration is a comparison of the statements in the FES from 2011 and 2016 in respect of hybrid EVs. In 2011 the FES stated that "Hybrids and plug-in hybrids will make up 27% of the total EV fleet in 2020,

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6 Some Tier 1 projects have become Network Innovation Allowance projects.

7 There is insufficient information in the public domain on the remaining three projects.

8 National Grid Future Energy Scenarios, July 2106.

9 Became the Department for Business, Energy and Industrial Strategy July 2016.

falling to 9% by 2030. However the most recent (2016) FES states "*In all but one of the scenarios, the number of hybrid vehicles exceeds the number of pure EVs*".

1.4 Future innovation funding

The Innovation Stimulus package provides partial funding for network related projects that provide a benefit for sustainable investment. This fund provides two separate 'pots' of money available under the innovation stimulus package; one is related to innovation on the gas networks; and the other is related to innovation on the electricity networks. Under the package, network licensee, and non- network licensee, parties[10] are eligible to apply for funding to progress projects at any stage of innovation – including research and development (R&D) trials and pilot schemes[11].

The main funding is split between two schemes: the Network Innovation Allowance (NIA) and the Network Innovation Competition (NIC), although funding is also available through Innovation roll-Out Mechanism (IRM). Under the NIC, partial funding is awarded through a competitive process.

As part of the eight-year transmission price control review for 2013 to 2021 Ofgem set the electricity NIC allowance at £30m per year. In the electricity distribution price control, which started on 1 April 2015, Ofgem increased the electricity NIC allowance by £60m per year (to a total of £90m) for the first two years of the electricity distribution price control. Before determining the electricity NIC allowance for 2017-2023 Ofgem decided to undertake a review of the LCNF.

This review comprises three elements:

1. An open letter consultation to seek stakeholder views on the LCNF and the NIC and NIA governance arrangements.
2. A summary of the key learning delivered to date by LCNF projects.
3. An evaluation of the LCNF and the extent to which it has delivered on its aims (this study).

The output from these three elements will firstly inform decisions on changes to the governance arrangements of the NIC and NIA and, secondly, inform the decision on the NIC allowance which will apply from 2017 until the end of the RIIO-ED1 price control period.

In addition, the LCNF includes a 'Discretionary Funding Mechanism' – worth £100m over the five year period[12] – which has enabled Ofgem to reward successful project delivery and also projects that bring 'particular value'[13].

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10 Non-DNO participants must be partnered with a DNO.

11 Except for innovation defined at Technology Readiness level 1 (basic principles observed and reported).

12 This £100m is part of the total £500 million funding.

13 This includes an assessment of the 'project timings'; 'assessment against successful delivery reward criteria'; and the 'assessing management of change' as well as rewarding projects where valuable learning is obtained and disseminated even if the expected benefits are not delivered.

1.5 The DNOs and innovation

Ofgem has initiated its thinking on the roles that DNOs are expected to have in a future energy system. This is articulated in the recent Ofgem position paper on flexibility[14]. This document considers the process of DNOs transitioning into Distribution System Operators. The document highlights a number of challenges the DNO will face during this process, for example they will need to operate the system more flexibly, have a closer relationship with the System Operator and have a greater involvement in local balancing. In addition the flexibility position paper outlines a number of recommendations to facilitate this transition. It is envisaged that as part of the DSO transition, there will need to be an increasing focus on DSOs making use of innovative and flexible solutions – such as those identified in the LCNF and Innovation Stimulus – to help operate the system in the most cost effective manner.

1.6 The aim of this evaluation project

The overarching aim of this evaluation is to understand the extent to which the aims of the LCNF have been met in supporting the future development of innovation in the industry.

A key part of this work has been to engage with those who have been involved in the LCNF, and also with those who have thoughts and views which have helped in the evaluation process. This has allowed us to develop and provide key insights for each of the main stakeholder groups. For example:

- **Ofgem** – the output from this evaluation will inform the decision on the future governance and funding of the NIC;
- **LCNF participants** – this evaluation has provided a vehicle for participants to 'have a say' on their experience of the scheme;
- **potential NIC participants** – the evaluation provides more information for potential future participants; and
- **other industry regulators** – other European regulators who may be looking at ways to stimulate innovation in their own markets.

This evaluation follows on from the study of 'LCNF learning' commissioned by Ofgem[15]. This project produced a summary of project learning and provides a view of the extent to which the DNOs have been successful in integrating LCNF projects into normal business practices. We have also drawn on some of the findings of a recent academic study on the outcome of the LCNF projects[16].

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14 https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/flexibility_position_paper_final_0.pdf

15 Summary of the Low Carbon Networks Fund learning, EA Technology, April 2016 (https://www.ofgem.gov.uk/publications-and-updates/ea-technology-s-summary-low-carbon-network-fund-learning).

16 University of Strathclyde. 'A Review and Synthesis of the Outcomes from Low Carbon Networks Fund Projects', September 2016 (http://www.ukerc.ac.uk/publications/a-review-and-synthesis-of-the-outcomes-from-low-carbon-networks-fund-projects.html).

1.7 Acknowledgements

Pöyry and Ricardo would like to thank the various industry players for their significant contribution to this evaluation report by volunteering their own time to engage with us through discussions, and by sharing their experiences via the questionnaires.

1.8 Sources

Unless otherwise attributed, the source for all tables, figures and charts is Pöyry and Ricardo.

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2. APPROACH TO THE EVALUATION

In this section we present our approach to the evaluation of the LCNF. We have undertaken both a qualitative assessment and a quantitative assessment and we recognise that a robust process will be vital in satisfying Ofgem's requirements for the evaluation of the LCNF.

To ensure this robust approach we have sought to ensure that the evaluation is, where possible, conducted in accordance with the requirements of the HM Treasury Green Book[17] and Magenta Book[18], along with Ofgem's own Impact Assessment Guidance[19].

2.1 Assessment criteria

Our assessment criteria are based on the aims and objectives of the LCNF – as defined by Ofgem. These criteria were used by Ofgem to understand whether or not a project proposed by a DNO was worthy of funding. We have taken these originally-stated aims and objectives to form a good basis for assessing the extent to which the LCNF has been successful. In addition to these criteria we have also been careful to take account of Ofgem's principal objective[20] and its statutory duties.

With this in mind we propose the evaluation of the LCNF is based on the following nine criteria.

Tier 1 and Tier 2 projects:

1. accelerates the development of a low carbon energy sector and has the potential to deliver net financial benefits to future and/or existing customers
2. generates knowledge that can be shared amongst all DNOs

Tier 1 projects only

3. has a direct impact on the operation of the distribution network
4. focuses on the network methods that are at the trialling stage
5. does not lead to unnecessary duplication

Tier 2 projects only:

6. provides value for money to distribution customers
7. is relevant and timely
8. evidence of involvement of other partners and external funding

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17 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf

18 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220542/magenta_book_combined.pdf

19 https://www.ofgem.gov.uk/publications-and-updates/impact-assessment-guidance

20 The Authority's principal objective is to protect the interests of existing and future consumers in relation to gas conveyed through pipes and electricity conveyed by distribution or transmission systems. The interests of such consumers are their interests taken as a whole, including their interests in the reduction of greenhouse gases in the security of the supply of gas and electricity to them and in the fulfilment by the Authority, when carrying out its functions as the designated regulatory authority for Great Britain, of the objectives set out in Article 40 (a) to (h) of the Gas Directive [3] and Article 36 (a) to (h) of the Electricity Directive.

9. demonstrates clear project methodology and shows effectiveness of implementation

It is with these criteria in mind that we have developed our evaluation methodology.

2.2 Evaluation process

Figure 1 presents the high-level process adopted for this evaluation. The process follows three core workstreams, these are as follows:

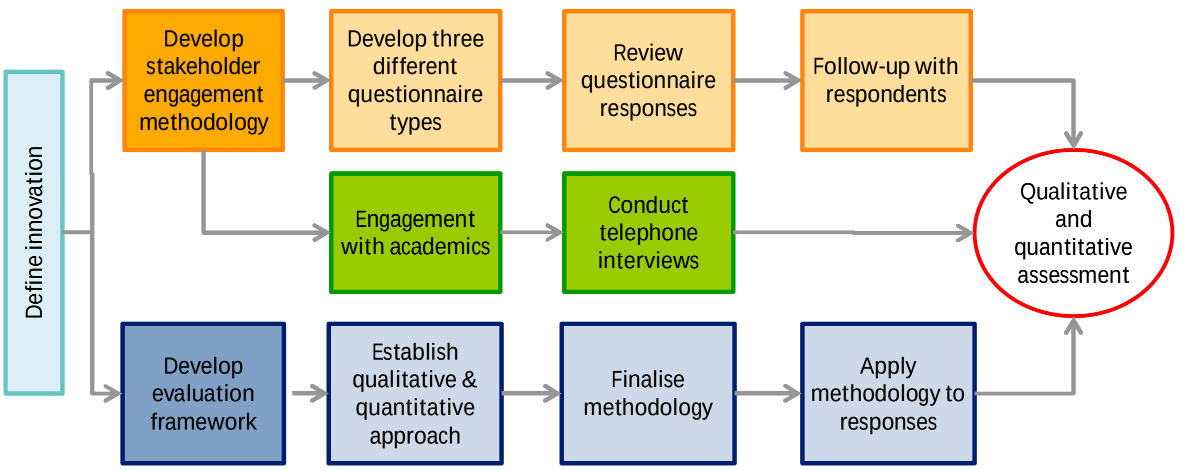
- defining what is meant by innovation;
- stakeholder methodology; and
- evaluation framework.

Initially we defined ‘innovation’ in the context of the GB DNOs – and this was subsequently used as part of the assessment process. This definition is a key input into the remaining two workstreams (more details on the definition of innovation are set out in 2.3).

The second workstream concentrates on the development of the ‘stakeholder engagement methodology’. The focus of this workstream has been to develop detailed questionnaires which were sent to a list of key stakeholders (including the DNOs, project partners, other industry and academics). The list has been developed in conjunction with Ofgem. More detail on the stakeholder engagement methodology is set out in Section 2.4.

The third workstream is concerned with the development of the ‘evaluation framework’. This has involved the development of a methodology for both the *qualitative* and *quantitative* analysis and the subsequent assessment. More detail on the evaluation framework is provided in Section 2.5.

Figure 1 – Approach to the evaluation



2.3 Defining innovation

This evaluation includes an assessment of innovation. So while the term innovation is broadly understood, (i.e. to make changes in something established, especially by introducing new methods, ideas, or products), the process of identifying whether a method, idea, or product is innovative is likely to be interpreted differently by different people. As part of this project, therefore, it has been necessary to both define what is mean by innovation in the context of the GB DNOs, and also to ensure that this definition is understandable and acceptable within the industry, and to key industry stakeholders.

An important part of this process has been the development of a definition for ‘innovation’ in the context of the GB DNOs; this was subsequently used as part of the assessment process. There are several definitions for innovation; however the following definition was agreed during discussions with the academics:

> *Innovation: changes in both technology and administrative/management practices that leads to an improved performance of the company. The improved performance can be demonstrated by a wide variety of financial and non-financial indicators.*

Building on this definition we developed and defined three different levels of innovation – ‘low’, ‘medium’ and ‘high’. A set of words was agreed with the academics and used to describe each of these different levels of innovation for discussions with the DNO businesses. The definitions are summarised in Table 1 and a full description is presented in Annex F.

By defining the level of innovation in this way, we have been able to estimate any change in the level of innovation in the DNOs over the period of the LCNF. This includes how ‘embedded’ innovation is in the business and culture of the DNOs, and therefore enables a view to be developed on the extent to which the current level of innovation – as observed in the DNOs – would continue if the innovation regulatory incentive was to be removed. This is expected to inform the future regulatory funding incentive programme for innovation in the GB electricity distribution sector.

Table 1 – Definitions of innovation

Innovation scenarios	Description of typical DNO attitude and activity
Low innovation	Little or no interest in innovation. Few projects, no overall programme examining opportunities. Limited links with external parties. Innovation regarded as being undertaken by manufacturers and others. Benefits not recognised by senior management.
Medium innovation	Some interest in innovation. Small number of projects, no overall programme examining opportunities. Some links with external parties. Innovation primarily something undertaken by others with DNOs involved at final trialling and pilot implementation stage. Implementation to business as usual (BAU) slow and risk-averse. Changes 'pushed' through by others (including the regulator) rather than 'pulled' by DNOs.
High innovation	Widely acknowledge internally as being vital to the success of the business. Senior management plays a major role in the innovation programme which prioritises an actively-managed, comprehensive programme and suite of projects. Clear process for identifying new opportunities and moving projects to BAU. Links with external parties pursued. Recognition and acceptance that some projects may fail.

2.4 Stakeholder Engagement Methodology

In this section we describe the methodology used for the stakeholder engagement. Our stakeholder methodology has been designed to be as inclusive as possible. With this in mind we created three stakeholder engagements plans; the first targeted those stakeholders with direct LCNF experience (this included **DNOs** themselves, and the LCNF **Project Partners** who worked alongside the DNOs); the second targeted other **Industry Stakeholders** who had not have been directly involved in LCNF projects to date; the third targeted the **Academics** who are active in the area of electricity networks and innovation.

For each stakeholder engagement plan we have identified (i) *who* to target; and (ii) *how* best to engage with them. The outcome was a list of individuals and companies who we should receive one of the three questionnaires. This list was developed and agreed with Ofgem prior to the questionnaire being sent.

2.4.1 Preparation of questionnaires

In parallel to the identification of the key stakeholders, we developed a set of questionnaires. The questionnaires were tailored to each of the four groups identified as in the stakeholder engagement plans:

- DNOs;
- project partners;
- industry participants (i.e. those not directly involved in projects); and
- selected academics.

The questionnaires have been specifically designed to draw-out details of involvement and experience in the LCNF, while at the same time providing important information to feed into the qualitative assessment of the LCNF. The questions included the following topics:

- success of the LCNF;
- innovation in GB (including relationship with the wider R&D framework);
- overview of the scheme (e.g. scheme administration, understanding of the requirements etc.); and
- engagement with the DNOs (e.g. for project partners).

Our approach also accounted for the fact that similar questions to stakeholders have been included in a recent Ofgem (open) consultation, and also as part of the study of 'LCNF learning' commissioned by Ofgem[15]. Therefore, in framing the questionnaires we have taken account of the questions that have already been asked as part of these previous initiatives.

Copies of each of the questionnaires are provided in Annex G.

2.5 The evaluation framework

The evaluation framework is designed to be robust and credible whilst also ensuring that it is both proportional and practicable given the information available. For both the qualitative and quantitative assessments we have drawn on the stakeholders to help understand the impact of the LCNF projects. As a result, the main analytical research has been primarily drawn from responses to the questionnaires.

The assessment is designed to evaluate the LCNF in terms of both the process and execution of the scheme, as well as on empirical evidence.

- **process evaluation**: we have qualitatively considered the design and implementation of the LCNF. Understanding the effectiveness of the design and implementation is a crucial factor in determining how reliably the outcomes of the LCNF are delivered; and
- **empirical (qualitative and quantitative) assessment**: we have used qualitative and quantitative information to test whether or not the LCNF was directly responsible for the innovative outcomes, or whether innovation would have occurred anyway.

We have used the questionnaires described in Section 2.4.1 to ensure a wide participation of stakeholders. We then assessed these responses to identify the key trends that would ultimately inform our recommendations.

2.5.1 Process evaluation

This part of the evaluation considers the impact of the Ofgem procedures and process on the outcome of the LCNF - i.e. focussing on how well the processes were designed (prior to implementation), managed (after implementation) and delivered. The process evaluation assessed:

- whether the qualification and evaluation criteria were appropriate and their timing of their use in the process;
- whether information about the scheme was communicated effectively; and
- whether there was sufficient transparency in the scheme.

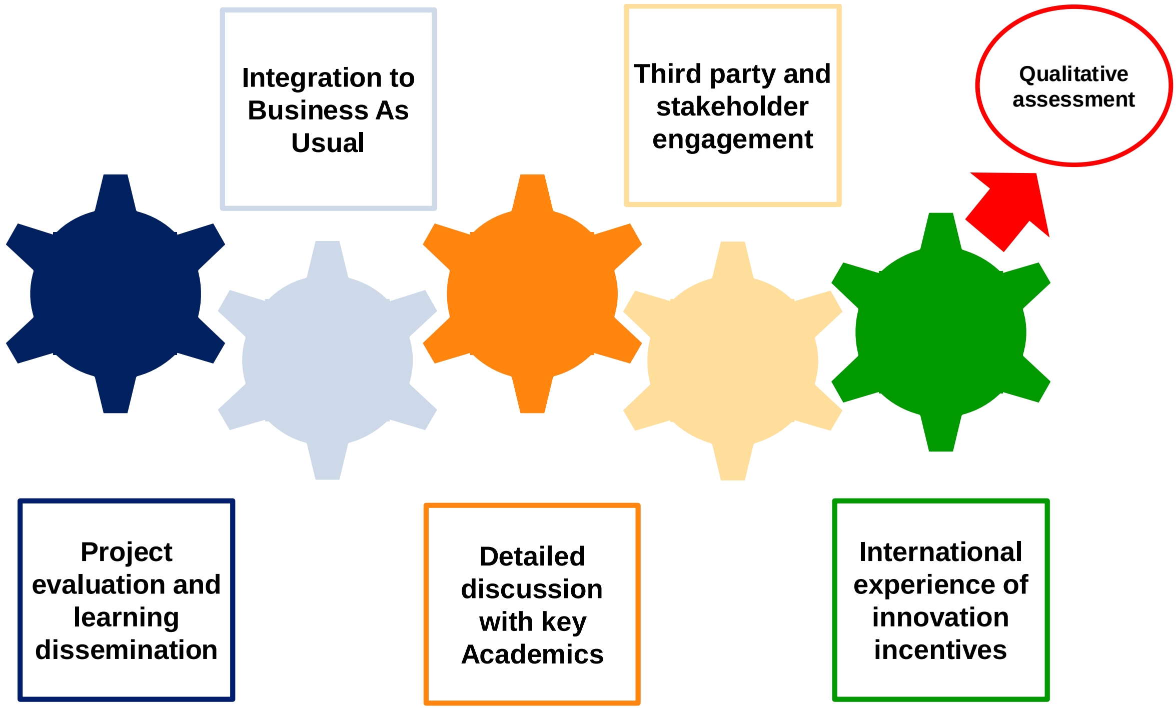
2.5.2 Qualitative assessment

Our qualitative assessment is driven by the feedback from key stakeholders, garnered from the questionnaire.

The questionnaire elicited high-level, qualitative data on stakeholders' experience of the LCNF projects. The emphasis was not on the detail of the individual projects[21] but instead had a broad focus, reflecting the assessment criteria set out above in Section 2.1.

21 Except where we needed to seek additional information on the individual projects and this information was not available from the 'LCNF learnings' work.

Figure 2 – Overview of the qualitative evaluation



- **Project evaluation and learning dissemination:** Each Tier 1 and Tier 2 LCNF project has been considered against the assessment criteria for technical quality, validity and significance. We have allocated a score against each criterion to rank the achievements of the projects.

  This assessment is designed to complement the assessment commissioned by Ofgem to establish key learning delivered by the LCNF projects to date, and the associated benefits.

- **Integration to business as usual:** We reviewed the findings of the recent study of 'LCNF learning' commissioned by Ofgem[15] and DNO innovation business plans to evaluate how the LCNF project learning has informed the DNOs business plans.

- **Detailed discussions with key academics:** We engaged with the academics and other research establishments involved in the LCNF. This enabled us to assess overlaps and gaps with other research funding provided to network companies.

  This included an assessment of how ideas move through academic early stage research, generally funded by the Engineering and Physical Sciences Research Council (EPSRC), and then on to further development and trials with increasing industry involvement with organisation such as Innovate UK, Energy Systems Catapult and the ETI.

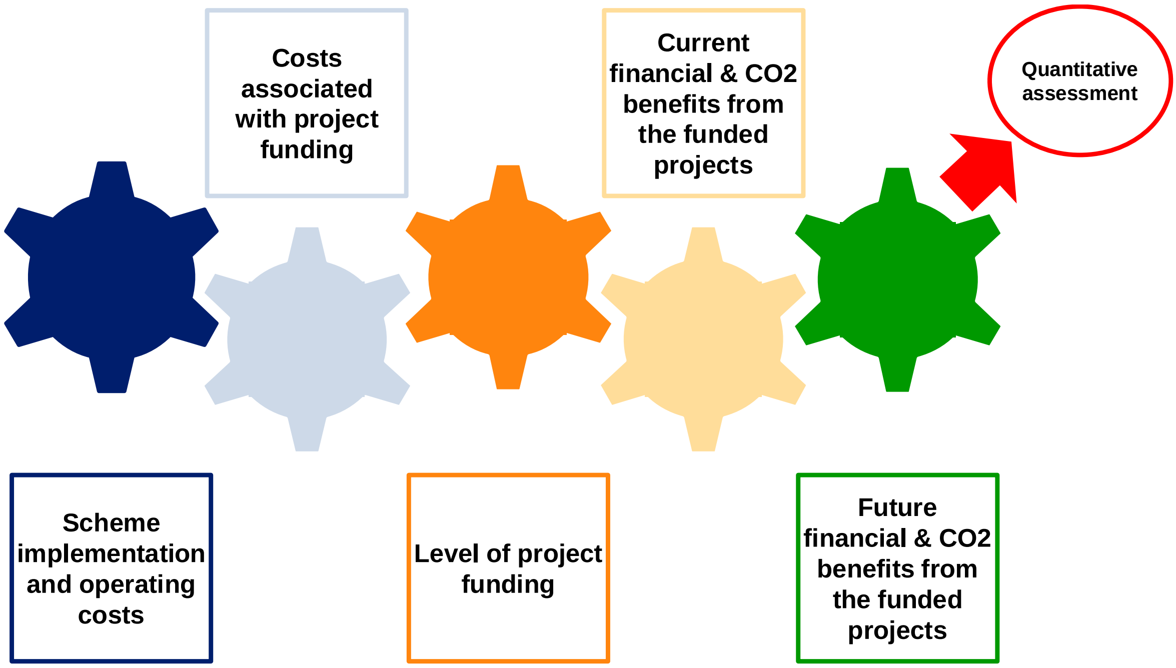
- **Third party and stakeholder engagement:** The LCNF projects have involved a wide range of third parties in consortia including manufacturers, SMEs, consultants and academics. In order to elicit the most comprehensive responses, we tailored individual questionnaires for each of the stakeholder groups.

- **International experience of innovation incentives:** We have undertaken a review of international innovation funding competitions, grants and innovation rewards. The aim of this review was to identify any lessons that can be learnt in respect of the innovative nature of the projects that are implemented under different competitive arrangements.

2.5.3 Quantitative Assessment

The evidence for our quantitative assessment is based on the DNO responses to our questionnaire. Figure 3 summarises our inputs to the quantitative assessment. More details on our approach are provided below.

Figure 3 – Overview of the quantitative assessment



Through the DNO questionnaire we have quantified the costs and benefits (where applicable and practicable) associated with the LCNF projects. In addition to the benefits identified by the DNOs in relation to projects, our assessment has also included the costs associated with the implementation and operating of the scheme. Each of the steps shown in Figure 3 are described below:

- **Scheme implementation and operating costs:** this covers the cost of administering the scheme. These are the costs borne by Ofgem through the need for additional staff, external advice etc.
- **Costs associated with project funding:** the actual cost of the LCNF projects; e.g. how much funding was granted by Ofgem to support the projects. This category also includes costs faced by the DNOs that were not covered by the LCNF. This includes an estimate of the cost incurred in preparing submissions (where applicable), including those submissions that were not successful.
- **<u>Current</u> financial and CO2 benefits from the funded projects:** Where possible we have identified financial or CO2 benefits that have already occurred as a result of the LCNF. For this evaluation work we have defined the 'current benefits' as being those up until 31 March 2016.
- **<u>Future</u> financial and CO2 benefits from the funded projects**: Given the uncertainty associated with future innovation, we have only monetised the potential

benefits where the results are identifiable and credible. For this evaluation work we have defined 'future benefits' as being those that accrue between 1 April 2016 and 31 March 2031 (the end of the RIIO-ED2 period)[22].

2.5.3.1 Analysing the data

Given the uncertainty associated with measuring the potential benefits associated with innovation, we have discussed above, we have only monetised the potential benefits where we believe the results are robust and credible and can be defended.

Following receipt of the information from the DNOs we have undertaken analysis and validation of the results. Given the nature and stage of the LCNF projects there are no independent sources of information available by which to verify the quantitative data. As a result, our analysis has been undertaken based on a review of other DNO submissions, for example this includes the reports published as part of the LCNF process and benchmarking between comparable projects. Specifically this process has included:

- cross-checking the results against other publically available data, such as project 'Close Down' reports and bid submission, to make sure that the estimated benefits had consistency;
- ensuring consistency within, and between, the DNO submissions. For example we looked at LCNF projects with similar innovation initiative to check for any major difference in the benefits estimated; and
- analysing the results to understand the different types of initiative being investigated by the LCNF projects. In doing this we drew on the academic classification system developed by the University of Strathclyde in its report on the LCNF[16].

Finally, we spoke individually with each of the DNOs to resolve any questions we had on the original information provided. During these discussions we resolved a number of potential issues[23] and through the clarifications we were able increase the robustness of the information provided. We are reasonably comfortable with the veracity of the data provided by the DNOs – recognising that these numbers would change if the DNOs had more time to undertake a more comprehensive assessment.

2.5.4 Defining a robust baseline

Essentially the quantitative element of this evaluation has attempted to identify any 'additionality' from the LCNF scheme. That is, what has been, or is expected to be, delivered in <u>addition to</u> what might reasonably be expected to have happened anyway. To understand this additionality we have established a 'counterfactual' position based on what we would have expected to happen if the LCNF has not been implemented. Establishing such a counterfactual is challenging, since by definition it cannot be observed – it is what would have happened if the policy had not gone ahead. A strong evaluation is one which is successful in isolating the effect of the policy from all other potential influences, thereby producing a good estimate of the counterfactual.

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22 This assessment period is, in general, shorter than the assessment period used by DNOs in their project closedown reports.

23 For example we identified examples of double counting of benefits between projects and differences in the potential benefits between the questionnaire response and other publically available reports.

Given the inherent difficulty of understanding what would have happened in the absence of the LCNF we have sought to identify an appropriate counterfactual through a qualitative process, supported by an assessment of the benefits identified by the DNOs in their responses to our questionnaire. Our qualitative approach to the counterfactual sought to identify a percentage of the financial benefits that may have occurred in the absence of the LCNF scheme. To estimate what this percentage could be we returned to the definition of innovations we described above in Section 2.3.

In discussion with key stakeholders, we assessed what the potential benefit of the LCNF might be, if the starting point of innovation (e.g. prior to the LCNF) was Low, Medium or High. For example, under an initial starting point of the high innovation scenario (where DNOs are strongly committed to innovation), a relatively high proportion of the benefits attributed to the LCNF would have happened anyway. Whereas under a low innovation scenario (where DNOs are demonstrating much less innovation activity), a much lower proportion would have occurred anyway.

Based on these discussions the view from the academic experts was that prior to the LCNF, the DNOs were at a low level of innovation prior to the LCNF scheme; and as a result only a small proportion of the reported benefits would have occurred anyway. The results of these discussions are presented in Table 2.

Table 2 – Counterfactual scenarios

Starting point Level of innovation	Benefit without the LCNF
Low	~20%
Medium	Unspecified
High	~100%

To better understand the robustness of the '20%' identified by the academics we used the estimated financial benefit numbers provided by the DNOs (as part of the quantitative assessment) in order to present a view of what this counterfactual position might look like in practice. When described in terms of the benefits associated with the connection of DG, a 20% counterfactual suggests that the majority of DG connections and, therefore, a significant proportion of the reported current benefits, would have occurred anyway and without support of the LCNF – mainly as a result of other policy aims and incentives put in place by Government[24].

Our view is that this does not seem unreasonable since although many of the DG connections have benefitted from the innovative solutions identified in the LCNF projects, it is highly likely that there would have been significant pressure placed on the DNOs to enable DG to connect. This is also the view of DNOs, who believe that many DG connections would have been made using 'direct inter-trip' arrangements for individual

[24] A 20% counterfactual corresponds with approximately two-thirds of reported benefits associated with the connection of DG – based on estimated project benefits.

generator units. As a result of Ofgem intervention DNOs have made significant improvements to better understand the requirements of their DG stakeholders such as the annual DG Forum[25] and DNO-specific DG stakeholder groups.

It is our view that, the pressure to connect would have come from both the generators themselves – who are seeking routes to market – and through the Government as part of their wider aims to increase electricity generation from renewable sources[26]. For example the development of financial incentives for DG will have significantly improved the business case for these generators who may have previously been put off by high connection costs. We believe that this pressure would have led directly to DNOs finding solutions to the challenges of connecting a significant number of renewable DG, even in the absence of LCNF project funding.

On this basis, and for our quantitative analysis, we have assumed that 20% of the overall benefits reported by the DNOs arising from the LCNF projects and initiatives would have occurred anyway and in the absence of LCNF projects.

We are aware however, that there is a significant level of uncertainty associated with attempting to quantify the benefits associated with '*what might have happened*'. For example, whilst it is true that the majority of DG connections to date have not used alternative connection arrangements developed through LCNF, this could reflect an amount of existing 'surplus capacity' on parts of the distribution network; and that over the last 18 months the networks have become increasingly constrained and further connections will increasingly rely on LCNF-derived solutions.

There is an alternative view that without the LCNF the amount of DG connection would have been less significant. For example, it is possible that without the LCNF, DNOs would not have been exposed to the same level of accountability to connect DG.

In recognition of the uncertainty associated with the counterfactual we have undertaken sensitivity analysis around the 20% level when estimating the net benefits[27].

Our rationale for the counterfactual focuses on the connection of DG rather than on other LCNF projects that may be of more direct benefit the DNOs. Without any specific low carbon incentive our view is that DNOs are more likely to focus on shorter-term 'within price control' benefits – associated mainly with reduced levels of network expenditure[28].

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25 The DG Forum was established by Ofgem in 2011 to enable DG customers and DNOs to discuss issues and steps taken to improve arrangements. From 2013 these events have been organised by the Energy Networks Association (ENA) on behalf of the DNOs. DG technical forum meetings are also held regularly between the DNOs and industry bodies to discuss and address DG connection issues and share best practice, a better understanding of technical constraints and the development of agreed solutions.

26 For example the government has an obligation to deliver low carbon technology as part of the EU 2020 targets, and the commitment under the Climate Change Act for the UK to reduce its emissions by at least 80% from 1990 levels by 2050.

27 See Section 5.3.4.1.

28 Ofgem Performance Report: Electricity Distribution Company performance 2010 to 2015. December 2015 identifies that the DNOs spent less on network investment and that the final RAV value was lower than forecast.

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3. EVOLUTION OF INNOVATION IN THE GB DNOS

One of the high level aims of the LCNF has been to achieve a culture change within DNOs with respect to innovation becoming a core part of their business and hence this section considers how innovation within the DNOs has changed since the introduction of the incentive scheme.

3.1 DNO Innovation Teams

Prior to the introduction of the LCNF, innovation within DNOs was generally led by a Research and Development Manager who usually had responsibility for working with the whole organisation to interpret business challenges and to scope out innovation projects. Since the introduction of the LCNF, Future Networks Groups have developed. The Future Network Groups typically have responsibility for some or all of the following business areas.

- project innovations;
- transfer of knowledge, for example from other DNOs, National Grid, gas distribution and academics;
- strategy and expert knowledge in developing areas;
- stakeholder representation;
- policy updates; and
- development of business as usual roll-out.

In some DNOs staff in the main business, rather than the Future Network Group, are identified at an early stage in the innovation project to become involved with the trial stage and take responsibility for BAU roll-out.

The number of technical, commercial and support staff have changed as the projects have started, progressed and completed. This change is illustrated in Figure 4 to Figure 6 for technical, commercial and support staff respectively over the period of the LCNF for the six DNOs combined. These figures have been provided by the DNOs and are based on judgement with respect of roles and full-time equivalents and exclude partner organisations. As well as an expected growth in technical staff, of significance is that the teams have developed dedicated commercial and support teams to manage the projects. The support teams in NPG and UKPN specifically include IT which is one reason why their staff number may be higher when the Customer Led Network Revolution (CLNR) and Low Carbon London (LCL) projects were being delivered. The DNOs generally supplement their permanent resource with short term contract, temporary agency, consultant, and partner staff, as the projects require it.

Figure 4 – Growth in future networks technical staff (all DNOs)

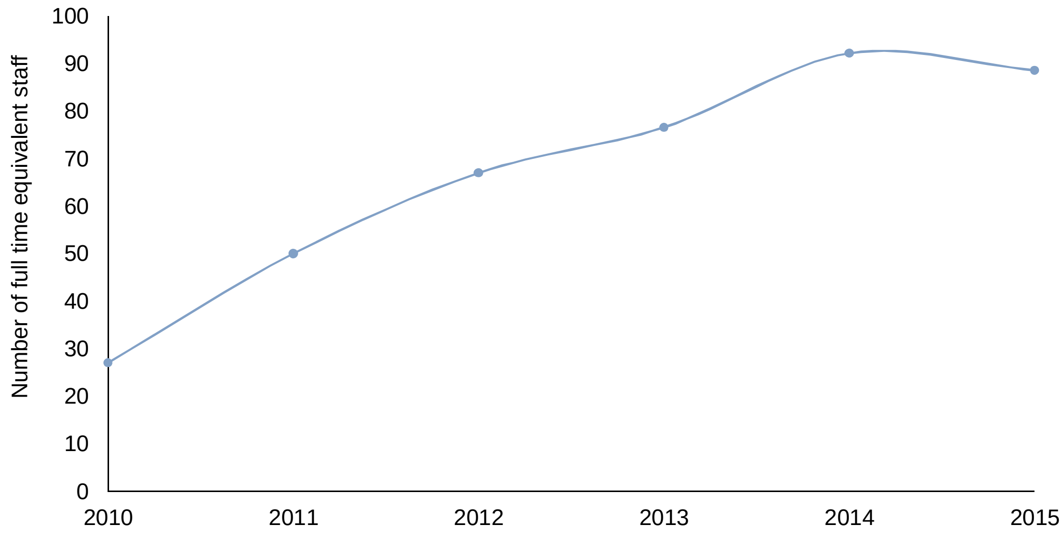


Figure 5 –Growth in future networks commercial staff (all DNOs)

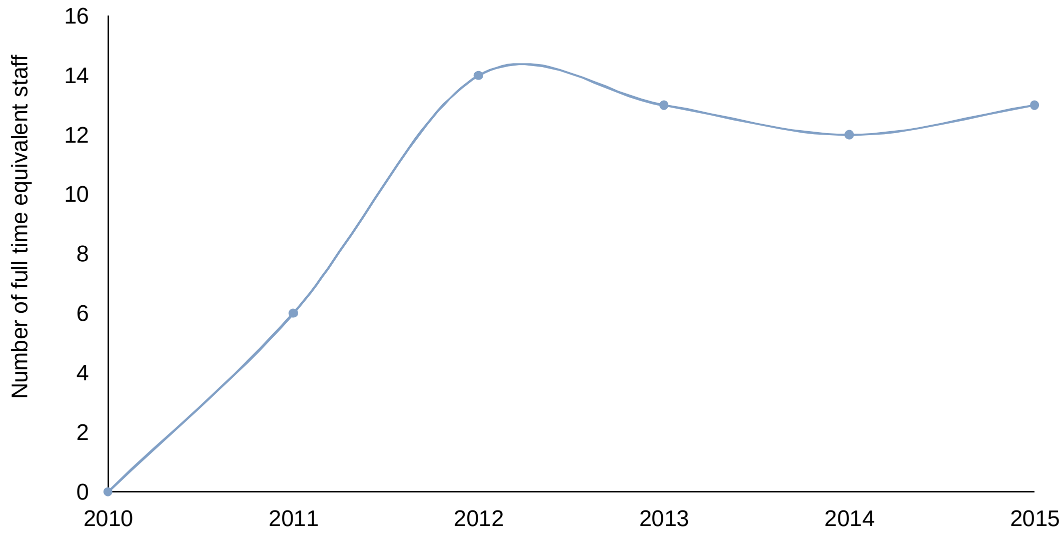
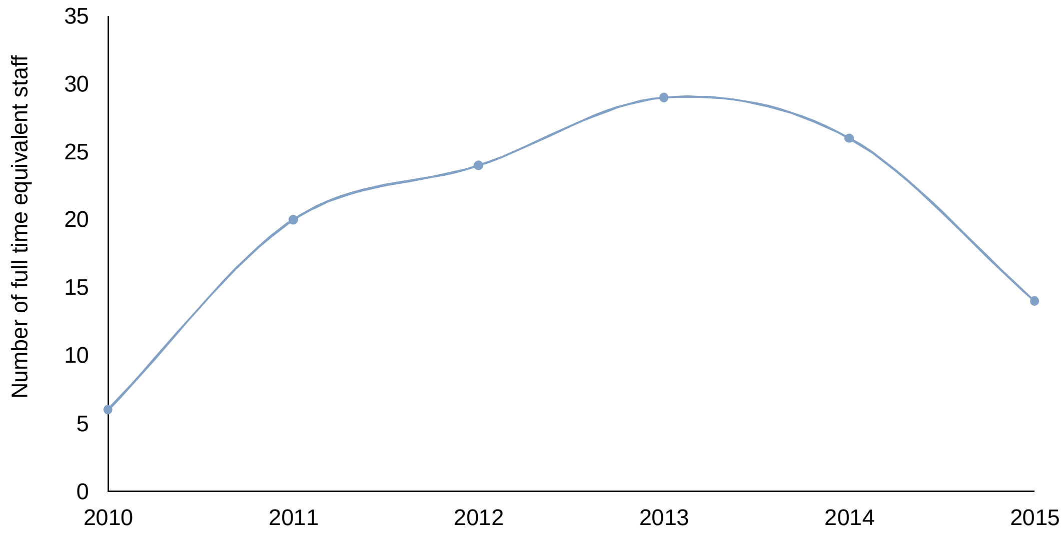


Figure 6 – Change in future networks support staff (all DNOs)



3.2 Innovation throughout the DNOs

From the information provided by the DNOs there are various approaches to staff movement in and out of the Future Network Groups and in the involvement of other parts of the business in the LCNF projects.

Some DNOs have a policy of seconding staff from others parts of the business to the Future Networks group on a project-by-project basis, whereas others prefer not to actively rotate staff – although there is usually some natural staff migration.

Business champions for each project may be appointed from within the main business areas to drive the change into the main business. In at least four DNOs staff have moved from the innovation team with their project into the main business to take up more senior management positions or to support delivery. Specific examples of a change to the business structure occurring as a result of LCNF projects are as follows:

- WPD undertakes delivery of each project aspect at a task level using BAU line teams. Local teams do all construction work, telecoms team install new data links, control room despatch DSR, IT provide the computers, etc. By doing this WPD aims to ensure that all business areas are exposed to innovation and understand their role in adapting the business and network to cater for changing customer needs.
- SSE has created an Active Solutions team which is designed to effectively transfer the skills, competencies and experience developed in delivering research and development projects into the business. The intention is that this provides a fast-track route for deploying innovations efficiently and supports their ongoing operation in order to secure maximum benefit. The Active Solutions team is responsible for the delivery of projects such as further Active Network Management (ANM) deployments or the Constraint Managed Zone project.
- UKPN has established a SmartGrid Development function within the Asset Management directorate. This group oversees flexible DG approaches, the policy towards energy storage, transmission and distribution interface issues.

- NPG has increased the number of external interactions that inform and guide its activities. They now routinely seek-out opportunities to collaborate with other DNOs on areas of strategic interest and are actively engaged with water and gas distribution projects through the Northern Joint Utilities Innovation Group. NPG has also established an agreement with Newcastle University to support its Future Energy Systems Hub.
- SPEN operational business has changed due to the adoption and implementation of innovation, for example Rezap and the BIDOYNG device from Kelvatec which have changed LV fault location methods. The design teams are adapting to the rollout of flexible connection offers made possible through the LCNF funding mechanism.
- ENWL has also undergone operational business changes for example the introduction of a managed connections process within the main business came about directly as a result of its Capacity to Customers project and has resulted in significant changes to the way in which generation customers are quoted and ultimately connected. ENWL has observed that this has led to a more mature relationship with generation customers requiring the connection customer liaison teams to work closely with customers to better understand their connection requirements. ENWL is now moving the principles into demand connections and are proactively engaging with a number of existing customers with a view to entering into demand side response contracts to assist with the network reinforcement challenge.

An illustration of how innovation is currently viewed and has been taken to the core of the DNO business comes from the recent (Spring 2016) UKPN Head of Innovation Job advertisement:

> *Reporting to the Director of Safety, Strategy & Business the Head of Innovation has overall accountability to ensure that UK Power Networks is identifying, prioritising and implementing best practice solutions.*
>
> *Championing innovation and building support across the organisation.*
>
> *Working with own team and colleagues across the business to encourage and facilitate innovative products, services and processes.*
>
> *Responsible for providing appropriate leadership, resources and expertise to ensure that innovation really happens and UK Power Networks is regarded as both the thought leader and the best at driving value from innovation.*

Our view is that this suggests that UKPN intends innovation to be considered across the whole business, not just within the Future Network Group.

3.3 Research and Development spend

The total DNO spend on research and development (R&D) has inevitably increased following the introduction of the LCNF. Information on R&D expenditure has been provided by five DNOs and is illustrated in Figure 7. This shows that the spend funded by other mechanisms, mainly the Innovation Funding Initiative (IFI), has remained relatively constant over the LCNF period and from Figure 8 – which includes the years prior to the introduction of LCNF – the total expenditure can be seen to be relatively stable for the two DNOs who provide this history.

Some DNOs obtain research funding from other sources such as the Technology Strategy Board[29] (Knowledge Transfer Partnership with university), Energy Technology Institute (ETI) and the European Union (EU) but the magnitude of this is a factor of ten, or even a hundred times, smaller than that obtained from IFI.

Figure 7 – Nominal spend on R&D SPEN, UKPN, WPD, NPG 2010 – 2015[30]

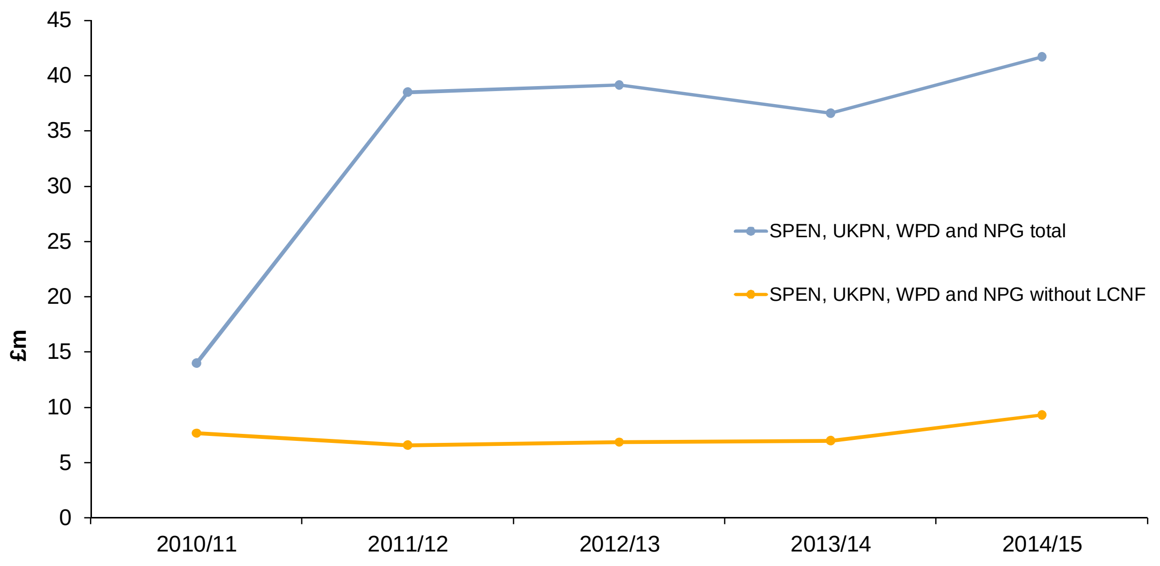
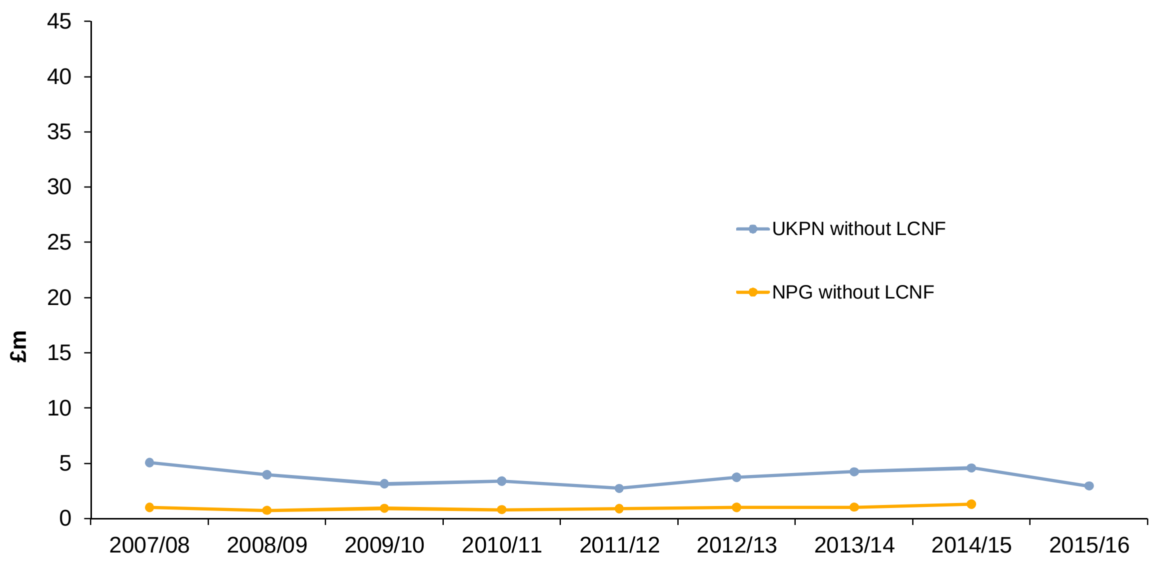


Figure 8 – Nominal spend on R&D (excluding LCNF) UKPN and NPG 2007 – 2016[31]



29 Now Innovate UK.

30 SSE Tier 2 project figures provided evenly spread across applicable years; ENWL figure not provided.

31 Data for years prior to LCNF provided by two DNOs and used for illustration.

3.4 DNOs approach to innovation within the LCNF

The DNO questionnaires included specific questions in respect of engagement with stakeholders, developing project ideas, third party involvement, sharing learning and the benefits of LCNF. The summary of the responses is given in Annex A with the key points covered in the next sections.

3.4.1 Stakeholders

The DNOs regularly consult with stakeholders about issues that are relevant to them e.g. reliability, affordability, sustainability of electricity or the development of commercial and technical solutions. Both formal and informal mechanisms such as the DG Forum[25] are used. The importance of stakeholder collaboration and contribution to developing and undertaking projects is recognised by the DNOs. Stakeholders are also directly involved with the generation of opportunities and ideas for LCNF projects.

Key stakeholders for LCNF project learning comprised various industry groups, Ofgem, DECC, wider government agencies, other DNOs, Energy Networks Association (ENA), academics, Association of Energy Producers, Citizens Advice, Smart Energy Demand Coalition and the public.

3.4.2 Project selection

A number of factors are considered by the DNOs when selecting projects. A key factor is to ensure that the projects are aligned with the company's business aims, as well as considering stakeholder requirements, benefits and the learning and outputs from the existing project portfolio, that of other DNOs and other sectors.

One DNO response claimed that it is careful not to duplicate projects that other DNOs are undertaking and that they undertake a certain amount of technical due diligence on the project ideas to discount ideas where they do not need the solution, the solution is clearly not cost effective or other technologies are expected which will solve the problem in a better way.

An example of the project selection process is that used by UKPN in 2013 associated with the 'Flexible Urban Network – LV' (FUN LV) project and the Vulnerable Customers and Energy Efficiency (VCEE) project. The full selection process is outlined in the project screening submissions[32] and can be summarised as follows:

- UKPN requested ideas from known project partners and suppliers, as well as new third parties. The sources of ideas were the UKPN Smart Grid Strategy; business led ideas as well as potential project partner ideas. Seven projects were consulted on with a wide-range of business stakeholders with operational, IT, asset management and connections viewpoints. UKPN also carried out an assessment of previous LCNF projects where they identified potential gaps that had not previously been explored. This highlighted that energy efficiency, end customer engagement and capacity sharing between different parts of the network had had limited focus. Hence UKPN decided to develop the VCEE and FUN-LV projects.

32 Low Carbon Networks Fund Full Submission Pro-forma, Vulnerable Customers and Energy Efficiency (VCEE).

3.4.3 Involvement of third parties

From the responses we received, all the DNOs feel that the involvement of third parties has increased the breadth of innovation and actively contributed to the success of the projects. SSE commented that hosting a third party to lead a technology trial encouraged the evolution of new service delivery models.

Intellectual Property (IP) was mentioned as a barrier by four of the DNOs, especially for Small – Medium Enterprises (SMEs) who depend on retaining their background IP and gaining from any foreground IP. It is recognised that managing IP can be difficult within the context of the LCNF; however addressing potential IP issues at an early stage would seem to increase the chances of successful collaboration. This was also identified by SMEs in their questionnaire responses[33].

3.5 Innovation in the DNO business plans

As required by the LCNF governance each DNO produced an Innovation Strategy Annex as part of their RIIO 2015- 2023 business plan. These all recognise the importance of innovation to help resolve the future challenges from the Low Carbon Technologies (LCTs) and some detail committed savings from their innovation portfolio which cover LCNF projects as well as IFI and others. Generally, however, information given in the innovation strategy document is at a high level and does not consistently detail the benefits or learning from the LCNF projects. The strategies given in the plans refer to smart grid/ network development plans/ strategies and cover technical themes, such as automation, DSR, storage, smart meters, ANM etc. and or innovation themes, such as safety and environment, network reliance, efficient, customer service etc. Again the level of detail in respect of the strategies and plans is not consistent across the DNOs and there is room for improvement with respect to the way innovation is considered by the all DNOs to ensure the LCNF learning and benefits are maximised as well as optimising the future innovation road map.

3.6 Summary

The work described in this section is associated with exploring the extent to which the LCNF has promoted a culture change within DNOs with respect to innovation becoming a core part of normal business. The DNO teams dedicated to LCNF – the Future Networks teams for example – have increased in size throughout the LCNF period as the requirements of the projects have increased[34]. Over the period 2010 to 2015 the total number of technical staff in the Future Networks teams, for the six DNO groups, increased from 27 to 90; the number of commercial staff dedicated to the LCNF projects went from zero to 14 and support staff increased from six to 29.

The DNOs have developed working practices to disseminate innovation throughout their organisations and it appears that they recognise the importance of innovation to help resolve the future business challenges[35]. Many DNOs also have strategies for project partner and stakeholder engagement which DNOs claims has increased the breadth of innovation and actively contributed to the success of the projects.

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33 As detailed in Section 4.4.3.2.

34 Numbers reduced slightly as some of the larger Tier 2 projects finished.

35 As outlined in the ‘Innovation Strategy’ annexes as part of the RIIO 2015- 2023 business plan.

The underlying R&D spend, excluding LCNF, has remained relatively stable suggesting that the stimulus that LCNF has provided has been key to the changes. Thus whilst we do find the DNOs have made significant progress in achieving a culture change we do not think innovation is yet a core part of their business.

4. QUALITATIVE ASSESSMENT OF THE LCNF

This section considers the LCNF projects individually and in terms of their innovation initiatives with respect to relevance and learning. It also looks at the aims of the LCNF and the qualitative responses received from project partners and industry representatives in this respect.

4.1 Individual project assessments – Tier 2 projects

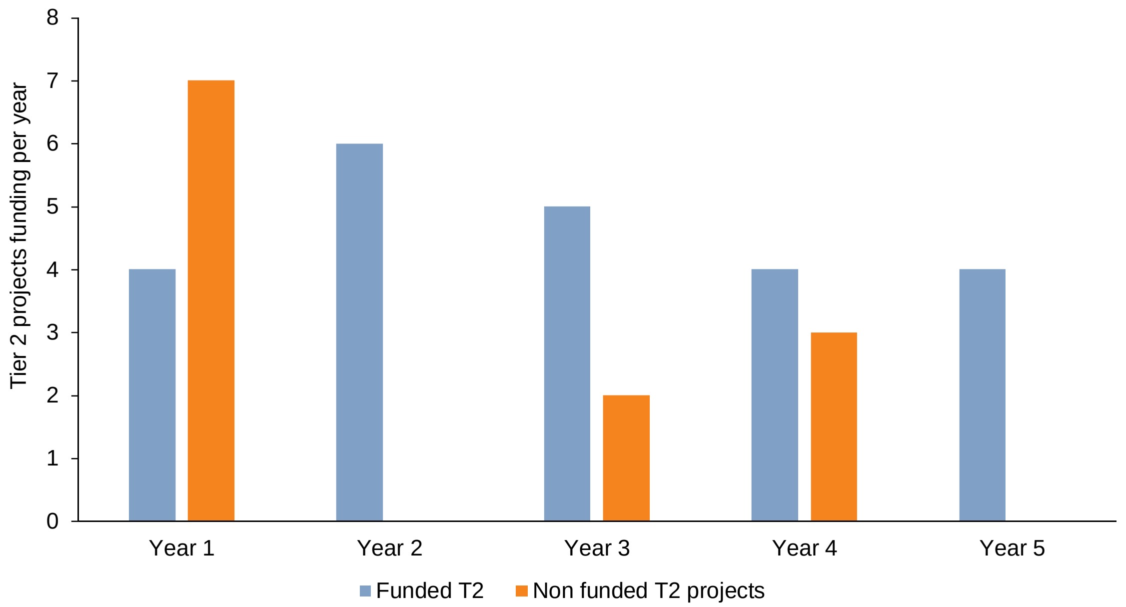
The Tier 2 projects are a small number of large 'flagship' projects which are funded through competition for an annual allocation of up to £64m.

4.1.1 Numbers of projects

The number of successful and unsuccessful projects that applied for funding each year is illustrated in Figure 9. A total of 23 Tier 2 projects have been funded over the five-year period of the LCNF. Twelve projects were unsuccessful with their initial applications and were not funded; one was funded on the second application[36]and one was funded via alternative means[37].

The large number of non-funded projects in the first year of the LCNF was, to a large extent, due to a duplication of ideas. In later years, projects were not funded because they did not demonstrate sufficient benefits to electricity customers.

Figure 9 – Tier 2 projects funding by year



[36] SSE's New Thames Valley Vision.

[37] SSE's Northern Isles New Energy Solutions (NINES) Project on Shetland was funded via changes to SHEPD's licence to enable the NINES proposal to be submitted as a part of the Integrated Plan and an associated adjustment to Allowed Revenues.

4.1.2 Individual project evaluation

As part of this evaluation all of the Tier 2 projects have been assessed against a set of criteria – drawn from the initial LCNF assessment criteria (see Table 3). The results of our assessment are provided in Table 4. More detail, in the form of the supporting evaluations, together with further information on the evaluation method used, is provided in Annex D of this report.

Table 3 – Criteria for Tier 2 project scoring

	1a	1b	2	3	4	5
Weighting	6		4	2	5	3
Title	Accelerates the development of a low carbon energy sector	Has the potential to deliver net financial benefits to future and/or existing customers	Generates knowledge that can be shared amongst all DNOs	Involvement of other partners and external funding	Relevance and timing	Effective project methodology, and effectiveness of implementation
Score 5 descriptor	The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits are credible and quantified.	Compelling evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to the majority of customers	Specific replication report(s) exist. These cover the main technical / commercial / stakeholder aspects as applicable. A learning dissemination event or webinar was held.	The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable External funding for > 10% of the project was obtained.	The project has been / is ready to roll out into BAU. Other DNOs have included the project in their business plans.	The project achieved all its successful delivery reward criteria (SDRC) and the variance was <10%
Score 4 descriptor	The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits not specifically quantified **OR** The project clearly facilitates one of the carbon benefits: Provide reactive power services/ Provide frequency response service/Defer asset reinforcement. The carbon benefits are credible and quantified	Compelling evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to selected group of customers	Specific replication report(s) exist. These cover the main technical / commercial / stakeholder aspects as applicable. There is no evidence of a learning dissemination event or webinar.	The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.	The project has been /is ready to roll out into BAU. The project has a high likelihood of being replicated by other DNOs.	The project achieved all its successful delivery reward criteria (SDRC) and there was no overspend >10%,however the variance was >10%
Score 3 descriptor	The project clearly facilitates one of the carbon benefits: Provide reactive power services/ Provide frequency response service/Defer asset reinforcement. The carbon benefits not specifically quantified	Evidence that the project is highly likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment)	A learning dissemination event or webinar was held but there are no specific replication reports	The project included one external partner covering some of the main technical / commercial / stakeholder aspects as applicable	The project is ready to roll out when the energy landscape requires the solution The project has a reasonable likelihood of being replicated by other DNOs	The project achieved all its successful delivery reward criteria (SDRC) but has an overspend of > 10%
Score 2 descriptor	The project just demonstrates carbon benefit with respect to increasing energy efficiency.	Evidence that the project may deliver short-term financial benefits to a limited group of customers (e.g. associated with asset replacement deferment)	The only replication information available is in the closedown report.	The project included one external partner covering one specific aspect.	The project has been / is ready to roll out into BAU when the energy landscape requires the solution The project has potential for replication in niche situations or by third parties.	The project achieved >80% of its SDRCs
Score 1 descriptor	The project does not clearly demonstrate any carbon benefits.	Little or no evidence that the project will deliver any significant benefit to customers at any time in future	No dissemination or replication documentation is evident.	The project did not involve any external partners.	This is a one off project with no potential for future replication.	The project achieved <80% of its SDRCs

Table 4 – Tier 2 qualitative project assessment summary

		Category	Assessment					Total Weighted Technical Score (max score 100)
		Weighting	6	4	2	5	3	
DNO	Status	Project title	Accelerates the development of a low carbon energy sector	Generates knowledge that can be shared amongst all DNOs	Involvement of other partners and external funding	Relevance and timing	Effective project methodology, and effectiveness of implementation	
DG Connection								
UKPN	Completed	Flexible Plug & Play (FPP)	5	5	5	5	5	**100**
WPD	Completed	Low Carbon Hub (LCH)	4	5	4	4	5	**87**
UKPN	New	Kent Area System Management (KASM)	5	Not scored	4	Not scored	Not scored	
SPEN	Underway	Accelerated Renewable Connections (ARC)	4	Not scored	4	Not scored	Not scored	
WPD	New	Network Equilibrium (NE)	4	Not scored	Not scored	Not scored	Not scored	
Fault level management								
ENWL	New	Fault Level Active Response (FLARE)	5	Not scored	4	Not scored	Not scored	
WPD	Underway	FlexDGrid	5	Not scored	4	Not scored	Not scored	
Flexible demand								
ENWL	Completed	Capacity to Customers (C2C)	4	5	5	5	4	**91**
WPD	Completed	Flexible Approaches to Low Carbon Optimised Networks (FALCON)	4	5	5	3	5	**84**
SSEPD	Completed	My Electric Avenue (MEA)	5	5	5	3	5	**90**
SSEPD	Underway	Solent Achieving Value for Efficiency (SAVE)	2	Not scored	4	Not scored	Not scored	
UKPN	Completed	Low Carbon London (LCL)	5	5	5	3	4	**87**
UKPN	Underway	Vulnerable Customers and Energy Efficiency (VCEE)	4	Not scored	5	Not scored	Not scored	

		Category	Assessment					Total Weighted Technical Score (max score 100)
		Weighting	6	4	2	5	3	
DNO	Status	Project title	Accelerates the development of a low carbon energy sector	Generates knowledge that can be shared amongst all DNOs	Involvement of other partners and external funding	Relevance and timing	Effective project methodology, and effectiveness of implementation	
Asset rating								
SPEN	Completed	Flexible Networks for a Low Carbon Future (FNLCF)	4	5	4	5	5	**92**
Storage								
WPD	Completed	SoLa BRISTOL	4	5	5	2	3	**73**
UKPN	Underway	Smarter Network Storage (SNS)	4	Not scored	4	Not scored	Not scored	
Network configuration								
SSEPD	New	Low Energy Automated Networks (LEAN)	5	Not scored	Not scored	Not scored	Not scored	
UKPN	Underway	Flexible Urban Network - Low Voltage (FUNLV)	5	Not scored	4	Not scored	Not scored	
Visibility								
WPD	Completed	LV Network Templates	5	5	4	5	5	**98**
ENWL	Underway	Smart Street (eta)	5	Not scored	5	Not scored	Not scored	
SSEPD	Underway	New Thames Valley Vision (NTVV)	5	Not scored	5	Not scored	Not scored	
Voltage Control								
ENWL	Completed	Customer Load Active System Services (CLASS)	4	5	5	4	4	**86**
NPG	Completed	Customer Led Network Revolution (CLNR)	5	5	5	4	5	**95**

From this assessment of the Tier 2 projects we note the following:

1. The projects have all contributed to the acceleration of the development of the low carbon energy sector. Development of the sector and benefits are mainly associated with:
   - connection of distributed generation without the need for expensive network reinforcement – saving generator customers both time and money;
   - deferral and avoidance of replacement or augmentation of assets which is driven by increased fault levels due to more meshing of networks, large motors and synchronous generation; this should result in lower DUoS charges;
   - customer benefits associated with lower DUoS charges as a result of the use of alternatives to conventional reinforcement;
   - customer benefits from DUoS charges as a result of the deferral of reinforcement (until such time as the reinforcement is required); and
   - customers served by meshed networks or networks to which automated load transfer has been applied are likely to experience fewer supply interruptions and/or interruptions of shorter duration (CI and customer minutes lost, CML).
2. Knowledge dissemination has been good across the completed projects; however some of the projects which are still underway appear to have better ongoing dissemination and provision of information than others. In some cases only the project submission documents and six monthly reports are publically available.
3. There is little evidence of knowledge co-ordination which would maximise the value of the LCNF projects, ensure that the DNOs are able to combine and use learning from all projects and inform the direction of future projects[38].
4. A range of partners and other stakeholders have been involved with the projects which was one of the LCNF aims and which is discussed in more detail in Section 4.4.
5. Business as usual activity associated with a variety of innovation initiatives, and drawing on different technologies or commercial techniques, have been developed as a direct result of LCNF projects. These are summarised in Table 5.

38 This is considered by WIPRO in its report: Maximising the Learning Benefits from the LCNF. The learning from the projects has also been summarised in the April 2016 EATL report[15] where the projects are mapped to solution areas and where the contribution from several projects to learning in a particular area is observed to build confidence. WIPRO also recommends the use of a knowledge management platform, project categorisation and use of a common format and language to make data sharing easier.

Table 5 – Overview of Tier 2 projects and BAU

Innovation initiative	DNO & Tier 2 project	BAU activity description
DG connection	UKPN - Flexible plug and play (FPP)	Some connections are likely not to have proceeded. Others may have proceeded but the connection cost would have lengthened the payback period for developers.
	WPD – Low Carbon Hub (LCH)	WPD has advised that a large number of generation developers have requested and accepted offers in East Lincolnshire as a way of unlocking capacity in areas otherwise considered constrained. Other DNOs are also using the learning from LCH to develop their own policies and procedures for 'alternative connections'. The learning from LCH has evolved into Network Equilibrium. WPD has five live ANM zones and are rolling out new zones every 6 months to achieve complete coverage by 2021. Timed, soft-inter-trip and export-limited connections can be used by customers to connect in all four licence areas.
	SPEN – Accelerating Renewable Connections (ARC)	Over 50 MW of DG has been connected at 33kV and 11kV – as well as a significant amount of LV generation – under the ARC project. Through ED1 and into ED2, SPEN intends that a roll-out of new commercial arrangements will be implemented to allow future DG and Distributed Energy Resource (DER) customers to connect to the distribution system without the need for network reinforcements. The uncertainty around an evolving energy market must be considered when implementing a BAU roll-out strategy in order to avoid future conflict between 'managed' connections and future actions taken by the system operator (SO) or local system operators in the form of a (DSO).
	NPG – Customer-Led Network Revolution	In ED1, NPG is intending to roll-out coordinated control as a BAU solution as a faster and cheaper solution for the connection of DG to congested parts of the distribution system.

Visibility	WPD – LV Network Templates	'Reusable templates for substations' has been rolled out within WPD. The templates can, with an 82.2% level of accuracy, estimate the load and voltage flows at a given LV substation without the need for costly monitoring. PV diversity factors have been updated. Voltage reduction has been deployed in South Wales, resulting in savings to customers. This is being rolled out across the business at selected substations.
Flexible Demand		A demand-side response (DSR) contract has been signed and more are expected.
	UKPN – LCL	UKPN advises that the first DSR contract has deferred reinforcement of £0.6m in the current year, and if it continues to defer the reinforcement at this site, it will deliver up to £1.9m of savings in the ED1 period. Without the DSR contract, work would have commenced to replace two 33kV/11kV transformers with higher capacity transformers.
	NPG – Customer Led Network Revolution	NPG advises that in ED1 it is likely to use industrial and commercial (I&C) demand post-fault response to manage the security of supply at major substations forecast to be occasionally loaded above capacity in the winter evening peak.
Asset rating	SPEN – Flexible Networks for a Low Carbon Future	Ten primary transformers are planned to have enhanced thermal ratings instead of traditional reinforcement.
	NPG – Customer Led Network Revolution	DG connection customers on a potential thermal constraint will be offered Real Time Thermal Rating (RTTR) on overhead lines and on transformers, to optimize the commercial viability the developers' schemes. RTTR be used on circuits that have DSM support as a means of triggering the DSM response.
Network Configuration	SPEN – Flexible Networks for a Low Carbon Future	3,600 monitoring devices are planned for deployment in ED1.

Voltage Control	ENWL – CLASS	ENWL is actively seeking to deploy CLASS across all of its primary substations in ED1. Benefits are associated with deferred asset reinforcement and provision of ancillary services.
	SPEN – Flexible Networks for a Low Carbon Future	2 sites have modified voltage settings to date
	NPG – Customer Led Network Revolution	ED1 plans consider learning in respect of: ▪ enhanced automatic voltage control at primary substations; ▪ secondary transformers with on-load tap-changers for PV clusters with voltage issues; and ▪ HV regulators for customer groups with significantly different load characteristics.
Large Scale Storage	UKPN – Smarter Network Storage	A £5.1m conventional reinforcement scheme is being deferred. Support to National Grid TRIAD, Short Term Operating Reserve (STOR) and frequency response.

6. The uncertainty about the future take up of LCTs has been an underlying factor throughout the lifetime of the LCNF. Some innovation initiatives are only suitable for roll-out once a requirement or need has been identified for the delivery of the solution. This can be policy-driven or market-driven. Whilst ‘proof of concept’ is important, it is recognised that solutions that rely upon rapidly advancing supporting technologies, such as communications, will inevitably be quickly out-dated and hence there is an optimum point to stop the solution development.

   Learning from the FALCON project has enabled WPD to identify that the uncertainty around communications requirements presents a significant barrier for DNOs which affects business decision-making. WPD is currently running an NIA project to research the optimal solution in more detail.

   For example, the SSE My Electric Avenue project has provided valuable information on how best to evaluate and deal with clustered EV charging on LV networks. This could have significant financial, time and customer satisfaction benefits once the take up of EVs increases.

7. Of the 11 completed projects, seven underspent the initial project budget, three of which underspent by more than 10%; three of the projects overspent by less than 10% and one overspent by greater than 10% - although in this latter case a review was held by Ofgem during the project and additional money was contributed by the DNO.

Thus, despite the challenges of managing innovation projects with their inherent uncertainty, the large Tier 2 projects have generally been well managed against their Successful Delivery Reward Criteria (SDRC).

8. SoLa Bristol, which considered a combination of energy storage in customer's premises, together with variable tariffs and integrated network control, was allocated a low score in our evaluation for 'project relevance and timing'.

   The project concluded that small-scale storage does not offer DNOs an immediate or medium-term opportunity to modify the distribution system to integrate PV and batteries. This should be reviewed once the storage market, where high costs have kept the market small, has matured. However it was noted that whilst the benefits are small for DNOs (when compared to implementation costs) there may be a business case for implementation by housebuilders, energy suppliers or Building Management companies.

4.2 Individual project assessment - Tier 1 projects

The Tier 1 projects are the smaller projects for which the DNOs were allowed to recover a proportion of the project cost. The Tier 1 projects are required to trial a new piece of equipment, arrangement or practice and to also meet the criteria in the LCNF governance document.

4.2.1 Numbers of projects

A total of 42 Tier 1 projects have been funded over the five-year period of the LCNF. One project was stopped when it was clear there was not a positive cost-benefit case. Other projects are ongoing.

4.2.2 Individual project evaluation

As part of this evaluation all of the completed Tier 1 projects have been individually assessed against a set of criteria – drawn from the initial LCNF assessment criteria with the exception of the criteria to avoid duplication which is discussed below. The results of the assessments are provided in Table 8. More detail, in the form of the supporting evaluations, together with further information on the evaluation method used and scoring criteria, is provided in Annex E of this report.

There are also a number of ongoing projects that have not been evaluated – these are identified in Table 6.

Table 6 – Tier 1 projects that were not included in the evaluation

DNO	Project	Reason for exclusion
SPEN	Hydro Active Network Management	Close down report not currently available[39]
SSEPD	Impact of Electrolysers on the Network	Ongoing[40]
WDP	Electric Boulevards	Ongoing
WPD	ECHO	Ongoing
SPEN	Smart Building Potential	Ongoing as NIA
UKPN	SULV	Ongoing
ENW	Fault Sense	Ongoing
WDP	Voltage Control System Integration - D-SVC Phase 2	Ongoing
UKPN	Power Transformer Real Time Thermal Rating	Ongoing as NIA
ENW	Combined On-Line Transformer Monitoring	Ongoing[41]

4.2.3 Consideration of duplication

One of the initial LCNF project eligibility criteria applied by Ofgem was that the projects should not lead to unnecessary duplication. In our assessment the projects have been grouped using the same categorisation as elsewhere in this report which has enabled consideration of this criteria.

There are a set of projects undertaken by individual DNOs at the start of the LCNF looking at LV monitoring equipment and LV networks. We have observed that there are some similarities between these projects in terms of the specifying the LV monitoring equipment, installation practices and data analysis. One of these projects was undertaken jointly by WPD and UKPN in the early years of the scheme to evaluate sensors to provide learning to all DNOs about this equipment. There are similarities and differences between DNO LV networks, both in the same licence area and between licence areas. Due to the lack of demand data about LV networks it could be viewed that these projects established techniques and DNO-specific procedures as a precursor to the larger Tier 2 projects – as well as providing an early insight into the effect of LV connected PV on specific networks

39 The project was a forerunner for the ARC project and was used to explore the technical and commercial issues that had the potential to jeopardise the successful delivery of the ARC project.

40 Information on benefits provided in Questionnaire response included.

41 Questionnaire response benefits included. Application of transformer oil regeneration can result in an improvement in overall condition which when used in combination with enhanced monitoring can extend the expected life of the transformer.

without unnecessary duplication. It is also perhaps not unreasonable to accept that at the beginning of the LCNF the DNOs were less experienced in sharing innovation ideas. With a stronger culture of openness and sharing between DNOs – something which was observed to develop over the periods of the LCNF – some of the projects involving LV monitoring could have been undertaken collaboratively possibly avoiding some duplication.

We have not identified other Tier 1 innovation initiatives overlapping with each other but have seen that the smaller projects often act as a useful building block to facilitate the larger Tier 2 projects.

Table 7 – Criteria for Tier 1 project scoring

Criteria	1a	1b	2	3	4
Weighting	10		5	5	2
Title	Accelerates the development of a low carbon energy sector	Has the potential to deliver net financial benefits to future and/or existing customers	Has a Direct Impact on the operation of a DNO's Distribution System	Generates knowledge that can be shared amongst all DNOs	Focuses on network Methods that are at the trialling stage (TRL 5 to 8)
Score 5 descriptor		Evidence that the project is likely to deliver financial benefits in the long term (ED2 and beyond) to the majority of customers	The project has been / is ready to roll out into BAU or outputs are utilised in later LNCF projects. Other DNOs have included the project in their business plans.	Specific replication report(s) exist / are available on request. A learning dissemination event or webinar was held.	Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment
Score 4 descriptor	The project clearly facilitates the connection of low carbon generation or demand.	Evidence that the project is likely to deliver financial benefits in the long term (ED2 and beyond) to selected group of customers	The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects. The project has a high likelihood of being replicated by other DNOs.	Specific replication report(s) exist / are available on request. There is no evidence of a learning dissemination event or webinar.	Solution moved to TRL8 (complete and qualified by end of trial), or commercial solution developed suitable for roll out
Score 3 descriptor	The project clearly facilitates one of the carbon benefits: Provide reactive power services/ Provide frequency response service/Defer asset reinforcement.	Evidence that the project is likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment)	The project is ready to roll out when the energy landscape requires the solution The project has a reasonable likelihood of being replicated by other DNOs	A learning dissemination event or webinar was held but there are no specific replication reports.	Solution moved to TRL7 (system prototype demonstrated in operational environment), or commercial solution demonstrated in operational environment
Score 2 descriptor	The project just demonstrates carbon benefit with respect to increasing energy efficiency.	Evidence that the project may deliver short-term financial benefits to a limited group of customers (e.g. associated with asset replacement deferment)	The project has been / is ready to roll out into BAU. The project has potential for replication in niche situations.	The only replication information available is in the closedown report.	Solution moved to TRL6 (technology demonstrated in relevant environment), or commercial solution demonstrated in restricted environment
Score 1 descriptor	The project does not clearly demonstrate any carbon benefits.	Little or no evidence that the project will deliver any financial benefit to customers.	The project is ready to roll out when the energy landscape requires the solution. The project has potential for replication in niche situations **OR** This is a one off project with no potential for future replication.	No dissemination or replication documentation is evident.	Solution has not progressed wrt technology level, or has not progressed wrt a commercial arrangement

Table 8 – Tier 1 qualitative project assessment summary

	Category		Assessment				
	Weighting		10	5	5	2	
	Project title	Completed	Accelerates the development of a low carbon energy sector	Has a Direct Impact on the operation of a DNO's Distribution System	Generates knowledge that can be shared amongst all DNOs	Focuses on network Methods that are at the trialling stage (TRL 5 to 8)	Total Weighted Technical Score
DG Connection							
WPD	Network Management on the Isles of Scilly	Nov-13	4	4	5	5	95
SSEPD	1MW Shetland NaS Battery	Jul-14	4	4	5	4	93
SSEPD	Orkney Energy Storage Park (Phase 1)	Nov-12	4	4	4	1	82
SSEPD	Trial of Orkney Energy Storage Park (Phase 2)	Jun-15	4	4	4	4	88
Fault Level Management							
NPG	33kV SC Fault Current Limiter	Jan-15	1	1	3	1	32
WPD	Implementation of AFLM Scheme	Mar-15	4	3	5	3	86
Flexible Demand							
SSEPD	Honeywell I&C ADR - Demand Response	Oct-12	4	4	3	5	85
SSEPD	Trial Evaluation of Domestic Demand Side Management (DDSM)	Oct-12	4	4	4	3	86
WPD	Community Energy Action	Jun-15	4	2	5	3	81
Asset Rating							
SPEN	Real-Time Thermal Ratings	Oct-13	4	3	3	3	76
SPEN	Windfarm Cable Circuits	Jul-15	4	4	2	5	80
Storage							
UKPN	Short Term Discharge Energy Storage	Jun-14	4	4	5	3	91
SSEPD	LV Network Storage	2014	4	4	3	3	81

	Category		Assessment				
	Weighting		10	5	5	2	
	Project title	Completed	Accelerates the development of a low carbon energy sector	Has a Direct Impact on the operation of a DNO's Distribution System	Generates knowledge that can be shared amongst all DNOs	Focuses on network Methods that are at the trialling stage (TRL 5 to 8)	Total Weighted Technical Score
Network Configuration							
ENWL	The Bidoyng Smart Fuse	May-14	4	5	4	5	95
SPEN	Clyde Gateway	Apr-14	4	3	4	3	81
Visibility							
WPD	LV Current Sensor Tech Evaluation	Sep-13	4	5	5	5	100
ENW	Low Voltage Network Solutions	Jun-14	4	4	5	2	89
SSEPD	Benefits of Monitoring LV Networks	Feb-13	4	5	5	5	100
WPD	PV Impact on Suburban Networks	Jan-14	4	4	3	5	85
UKPN	Validation of PV Connection Assessment	Mar-15	4	4	4	5	90
WPD	Early Learning of LV Network Impacts from Estate PV Cluster	May-13	3	4	2	5	70
SSEPD	LV Network Modelling & Analysis	Feb-13	4	4	2	2	74
ENWL	LV Protection and Communications (LV PAC)	Jun-15	3	4	2	5	70
UKPN	Distribution Network Visibility	Dec-13	4	4	5	5	95
SPEN	Ashton Hayes Smart Village	2013	4	5	3	4	88
WPD	Hook Norton Low Carbon Community Smart Grid	Dec-13	4	4	3	5	85
WPD	Interconnection of WPD and NGC SCADA	Mar-13	4	1	2	2	59
Voltage Control							
ENWL	Low Voltage Integrated Automation (LoVIA)	Dec-13	4	4	5	3	91
ENWL	Voltage Management of LV Busbars	Dec-13	4	4	5	3	91
WPD	Voltage Control System Demonstration Project	Sep-14	4	2	4	2	74
SSEPD	Digital Substation Platform	Apr-15	4	4	4	2	84

The overall observations from this assessment of the Tier 1 projects are as follows.

1. All Tier 1 projects have contributed to the acceleration of the development of the low carbon energy sector with benefits to the customers – in the same way as described for Tier 2 projects. Whilst not all projects have achieved Technology Readiness Level (TRL) 8 or 9 and have therefore been included into standard business practices a number have contributed learning to the Tier 2 projects as detailed in Table 9.

2. Innovation associated with the following technologies or commercial techniques are being used in BAU within the DNOs – as summarised in Table 10.

3. Knowledge dissemination has been less of a feature across the completed projects, when compared to the Tier 2 projects. It is generally less comprehensive and less readily available than for the Tier 2 projects, and for a large number of projects the only available information to assist a third party with replication of the project is in the closedown report, which is produced at the end of each project. This reflects the substantially lower project funding and allowance for dissemination. It has been noted that some of the hyperlinks in the older reports are no longer valid and information is not easy to find on the DNO websites. However the majority of closedown reports invite the reader to contact the DNO for further information.

Table 9 – Tier 1 project learning contribution

Innovation initiative	DNO & Tier 1 project	Learning contribution
Flexible Demand	SSEPN – Honeywell I&C ADR - Demand Response	Established aspects of technical functionality (performance of Honeywell's equipment in dropping the customer's demand), commercial customer engagement (liaison with key decision makers in diverse organisations), overcoming IT issues (firewall management) and the legal process (use of relevant standard clauses and recognition of risk allocation) which enabled the NTVV project to progress with the roll out of 30 demand response installations.
	SSEPN – Trial Evaluation of Domestic Demand Side Management (DDSM)	Demonstrated the functionality of a DDSM system, allowed further renewables to be connected on Shetland reducing the reliance on the oil fired power station. Additionally the new heating systems provide the home owners with a far greater degree of comfort and flexibility. There is also evidence to suggest that this has resulted in an energy saving for the majority of customers. The next step towards BAU deployment is being carried out through a large-scale roll out to 750 homes in Shetland the Northern Isles New Energy Solutions (NINES2) project.

Asset rating	SPEN – Implementation of Real-Time Ratings	Plans for this technology over the next 15 years originally depended on the connection requests for wind farms via new or existing overhead line networks. However, due to Government policy changes, the number of connection requests for onshore wind has been significantly reduced compared to the time when the project was conceived. The prime driver for Dynamic Line Rating (DLR) is now the alleviation of operational constraints on ≥132kV OHL networks. DLR technology is being considered for a 132kV interconnection between Barlaston and Crewe. SPEN anticipates that by the end of ED1/T1 they may have 1-2 circuits utilising a DLR solution, with the expectation of several others to follow in ED2/T2.
Fault Level Management	ENWL – Fault current active management	The learning from the trial of the innovative use of existing protection assets as an alternative to traditional methods and the use of existing and new assets for fault current management is being used in the RESPOND T2 project.
Network Configuration	SSEPN – Digital substation platform	The project helped progress and inform the future IT architecture required for substation protection, control and monitoring. The learning from this project has been used to inform discussion between SSEPD and NGETSO on the future ANM interface at GSPs and has assisted with a proposal for an NIA project.
	SPEN – Clyde Gateway	Over the course of ED1 and ED2 SPEN expects LV automation to become cost effective, expand in coverage and types of benefits. By the end of ED2 they expect each DNO to possess thousands of LV automation units.
	ENWL – The Bidoyng Smart Fuse	ENWL has deployed 646 Bidoyngs on the network (summer 2016) NPG LV automation - restore supplies to a significant number of customers following a transient fault.

	ENWL – Low Voltage Integrated Automation, Low Voltage Protection and Control	The project outputs are being used in the Tier 2 Smart Street project. The 'smart joint' developed in the project is a BAU technique for establishing means of voltage measurement on LV feeders at a point remote from a feeding substation. To-date 200 smart joints have been deployed. The enhanced protection and communication functionality for the Kelvatek load management devices, Weezap and Lynx will allow greater control on the LV network.
Large Scale Storage	UKPN – Short Term Discharge Energy Storage	Enabled UKPN and other DNOs to proceed with larger-scale storage projects, e.g. SNS (UKPN) and CLNR (NPG)
	SSEPD – LV Network Storage and Orkney Energy Storage Park	The project was the first in the UK to prove the theoretical benefits of energy storage such as peak shaving, phase balancing and voltage manipulation. Learning from the project also directly supported the implementation of a number of lithium ion-based energy storage projects within SSE and other DNOs – such as UKPN and NPG. Learning was gained in terms of the safety case installation and operation of the lithium ion batteries, and also in the cost of procuring, installing and operating the batteries. This allowed for the development of a code of practice and the establishment of the Energy Storage Operators Forum (ESOF).
Visibility	SSEPD – LV Network Modelling & Analysis	Identified the appropriate choice of power analysis tool to be used such that the impact of LCTs on the LV network could be appropriately assessed. Learning from the project fed into NTVV.
	WPD – Electric Boulevards	Provided a template for use as part of the planning toolset as and when the increase in demand for Electric Buses comes to fruition.

SSEPD – Impact of Electrolysers on the Network	The knowledge generated in the project will help DNOs to prepare and understand the potential impact of the wide-spread adoption of hydrogen vehicles including the potential impact of a roll-out of hydrogen refuelling stations and the alternative operational modes. This could avoid adding to local peak demand, reducing generation constraints, and also help avoid reinforcement. It could allow more renewable generation on to the grid and improve the amount of 'green' hydrogen which could be produced.
WPD / UKPN – LV Current Sensor Tech Evaluation	Enabled GB DNOs and vendors to better understand requirements and challenges, leading to better and cheaper LV monitoring products and practices. Demonstrated that they can be installed extremely quickly and efficiently.
SSEPD – Benefits of Monitoring LV Networks	Proved safety aspects of fitting monitoring equipment into live distribution substations and enabled NTVV to progress with substation monitoring to the time line necessary for the provision of data. Highlighted the high cost of monitoring and installation and initiated 'price challenges' on innovation via the EiC. Early outcomes indicate that monitoring costs can be reduced from £5,000 to £1,000 per installation.

Table 10 – Overview of Tier 1 projects and BAU

Innovation initiative	DNO & Tier 1 project	BAU activity description
DG connection	UKPN – Validation of PV Connection Assessment	The project’s extensive data set has been shared with industry. The tool is being used by two regions within UKPN, with staff the final region being trained.
	SSEPD – 1MW Shetland Battery	The battery is a key element of the larger NINES project. Without the NINES project, no new renewable generation would have been connected to the Shetland network and the island renewables would continue to be constrained by the technical limitations of an ageing oil fired power station. 8MW of renewables has displaced up to 15GWhrs of oil fired generation each year.
	ENWL – Low Voltage Network Solutions	29000 new connections of PV on the ENWL LV network in the year ending 31 March 2016. The ‘connect and manage’ approach (with monitoring) has resulted in the avoidance of any main line reinforcement as a direct consequence of these new connections.
Demand profiling	UKPN – Distribution Network Visibility	Used by designers and planners considering new connections. Asset engineers are able to review anomalous behaviour at substations, such as poor ventilation and poor phase balance. UKPN estimate that this project can save around £1m of lifetime benefits (present value) per licence area in manpower saving and by fixing assets rather than first being aware of their failure.
Dynamic asset rating	UKPN – Power Transformer Real Time Thermal Rating	One of the trial sites in the SPN area is actively deferring reinforcement with a total value of £1.25m
	ENWL – Transformer On-line monitoring	Approach to the asset replacement of Grid and Primary transformers has been revised to allow for the use of life extension techniques. Plans to deploy this technique on 80 sites in RIIO-ED1.

4.3 Project innovation 'initiatives'

This section considers one measure of success, which was suggested by the academics we consulted, as being related to the number of innovation initiatives that have arisen as a result of the innovation projects.

4.3.1 Introduction

The Tier 2 projects tend to be comprised of several separate innovation 'initiatives' and hence purely counting the number of discrete *projects* does not necessarily provide a good indication of the innovation value of the LCNF. As part of our evaluation work we have examined the Tier 2 projects in order to separately identify 'innovation initiatives'. In doing this we have used the same categories as used in a recent report by the University of Strathclyde[16]. These innovation initiative categories are as detailed in Table 11. One further category of Ancillary Services has been added.

There is some subjectivity in this assessment, but we believe that it provides a good overview of the range and number of initiatives, which total 118. This is further illustrated in Figure 10.

Table 11 – Categorisation by 'innovation initiative'

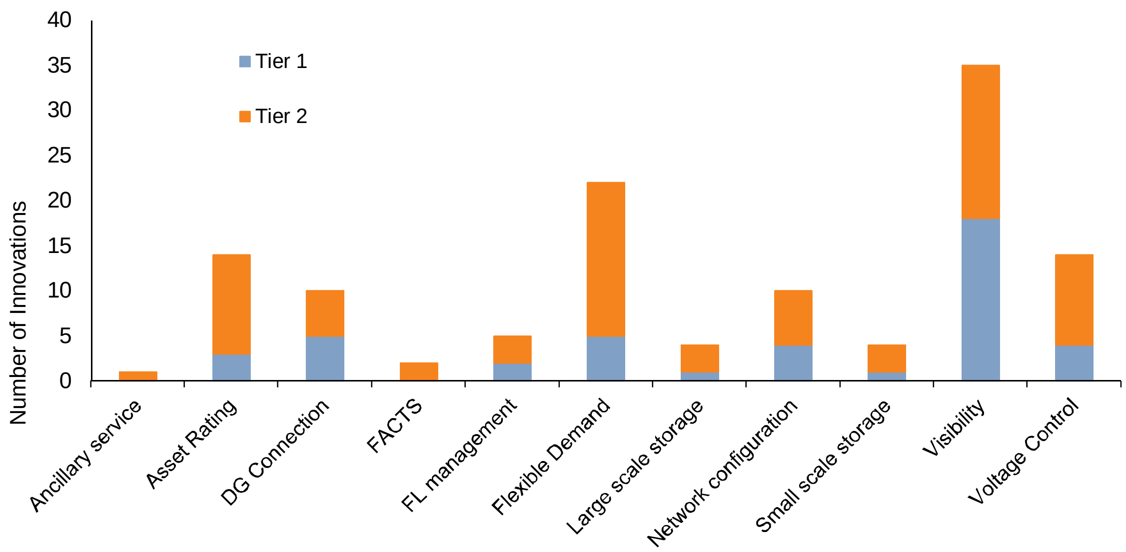
Category for innovation initiative	Brief description[42]	Technical significance[43] (refer to EATL Summary of the LCNF learning report for more details)	Number of innovation initiatives in Tier 2 projects	Number of innovation initiatives in Tier 1 projects
Ancillary service	Frequency response	Novel means to contribution to GB system stability	1	0
Asset Rating	Real time thermal rating – Overhead line, cables, transformers	Determination of accurate headroom estimation allowing the maximising of use of existing assets	11	3
DG Connection	Active network management	Facilitation of real time matching of generation to network capacity allowing generation to connect	5	5
FACTS	Flexible AC transmission systems	Enhanced power transfer and control of network	2	0
Fault Level management	Management of fault levels	Determination of mitigation techniques to avoid asset replacement	3	2
Flexible Demand	Industrial, commercial, residential time of use tariffs and controlled demand (electric vehicle charging)	Facilitation of real time constraint management allowing deferral of network reinforcement	17	5

42 A fuller description can be found in the University of Strathclyde, A Review and Synthesis of the Outcomes from Low Carbon Networks Fund Projects, May 2106 report.

43 Technical significance considered here is the ability of the technology to address current and potential future technical and commercial challenges related to the transmission and or distribution networks.

Large scale storage	Large battery demonstration	Determination of storage ability to solve network constraints and support balancing and stability of transmission system	3	1
Network configuration	Interconnected actively managed networks	Maximise the utilisation of network capacity	6	4
Small scale storage	LV battery demonstration	Determination of storage ability to mitigate distribution network constraints	3	1
Visibility	Enhanced monitoring, as an enabler to other solutions, demand profiling	Provision of data and information about assets to allow action to be taken – probably in conjunction with another innovative initiative	17	18
Voltage Control	Primary and secondary network voltage control	Demonstration of innovative voltage management techniques to allow connection of generation and demand without asset reinforcement	10	4
TOTAL			**78**	**43**

Figure 10 – Estimated number of innovation initiatives per category



4.3.2 *Potential for business as usual*

Whilst the definition of innovation includes the requirement for improved performance of the company, the criteria on which the LCNF projects were initially assessed and approved by Ofgem included the wider benefit to customers.

As part of our evaluation we have observed that one of the 'innovation initiatives' – 'DG Connection' – has, to date, consistently been successful in achieving roll-out into business as usual (BAU)[44]. For many of these projects, the DG customers have benefitted from lower costs to connect to the distribution network, and hence access operational revenue. There are also benefits to GB that arise from the displacement of carbon intense electricity generation[45].

It is noted that, in many cases prior to LCNF, connecting DG, based on conventional techniques, often required relatively expensive direct inter-trip schemes or major network reinforcement – often leading to a prohibitively expensive connection price to the DG proponent. Many schemes only progressed to connection due to innovative initiatives supported by LCNF.

As a result of the connection of distributed generation at all distribution voltage levels power flows, voltage profiles and demand profiles have changed and this is being managed by the DNOs and a number of the innovation initiatives have helped facilitate this.

44 In this report BAU is defined as an initiative which has transitioned into the daily business practice or consideration of the DNO thus realising greater benefits than demonstrated by the project alone. Some initiatives are defined as being ready for BAU once the energy landscape requires them because there is no current business case for adopting them immediately into BAU.

45 Further discussion on LCNF 'benefits', including those that fall outside of the DNOs, can be found in 5.3.2.

There is evidence that valuable learning has occurred across the portfolio of projects we have assessed, but the status of the network or the demand is not such that the innovation initiative is required in business as usual at the present time. For example, the investigations into primary substation voltage reduction identified that demand could be reduced without any impact on the downstream customers; the managed electric vehicle charging initiative showed that consumers are prepared to flex their EV demand and that primary and distribution substation storage can assist with management of congested networks. There is significant present uncertainty about the change in the demand that the networks will experience in the future due to the decarbonisation of transport and heat.

Benefits from LCNF projects that address increasing demand can be directly attributed to the DNO in relation to deferred expenditure in asset replacement or asset expansion (i.e. reinforcement and augmentation). Benefits can also flow to the customer through lower energy bills associated with demand management and energy efficiency.

Hence, from the perspective of successful transfer of innovation to BAU, we have categorised the projects into three groups:

1. new innovation initiative with BAU potential identified now;
2. new innovation initiative that is likely to contribute to a BAU innovative solution when required due to the take up of LCTs; and
3. initiatives that have contributed to learning, but where significant further work is necessary before a BAU solution is successfully developed and implemented.

The University of Strathclyde assessment[16] considers the evidence for whether or not the Tier 2 innovation initiatives are sufficiently developed to be deployed where appropriate. The approach uses a scale of -4 to +4; where -4 represents strong evidence against deployment and +4 represents strong evidence for deployment. This assessment criteria is used in our financial benefit assessment considered further in Section 5.

Our categorisation of the innovation incentives into the three groups identified above is based on:

- the DNO submissions which assigned current and future benefits to the projects;
- our project assessments; and
- the recent academic assessment[16] for completed Tier 2 projects and the methodology applied to the remaining Tier 2 projects and the Tier 1 projects.

Table 12 illustrates the split between the number of innovation initiatives from the Tier 1 and Tier 2 projects and the timescale in which they are likely to be deployed; just under 40% of initiatives are suitable for deployment into business as usual now; just over 40% of initiatives should contribute once the energy landscape requires them and just over 20% of the initiatives have contributed to learning but further work would be needed to obtain a business as usual solution. This is broken down by Tier 1 and Tier 2 projects Table 12 from which it can be seen the contribution of the initiatives for both Tier 1 and Tier 2 projects is similar. The overall allocation is summarised in Figure 11.

Table 12 – Deployment of initiatives

	Innovation Initiatives Tier 1	Tier 2	All
New innovation initiative with BAU potential identified now	40%	36%	37%
New innovation initiative that should contribute to BAU innovative solution when the energy landscape requires it	42%	40%	41%
Initiatives that have contributed learning, but where significant further work would be necessary before a BAU solution is obtained	18%	24%	22%

Figure 12 presents the information on 'BAU-readiness' by category from which it can be seen that, whilst most categories have initiatives that require further work, the largest concentration of these is in the asset rating area. This reflects the fact that whilst real-time thermal rating has been successfully deployed on some overhead line circuits there is still a requirement for further understanding and learning in the area of real-time thermal rating for cables and transformers. The LCNF project findings also observed that it can be expensive to install such a system and the benefit may not be justified.

There are a number of initiatives in the flexible demand category that require further work; these are associated with the trials of residential demand response which have not been successful in achieving a significant effect on demand.

Figure 11 – Innovation initiatives and the move to BAU (Tier 1 and Tier 2)

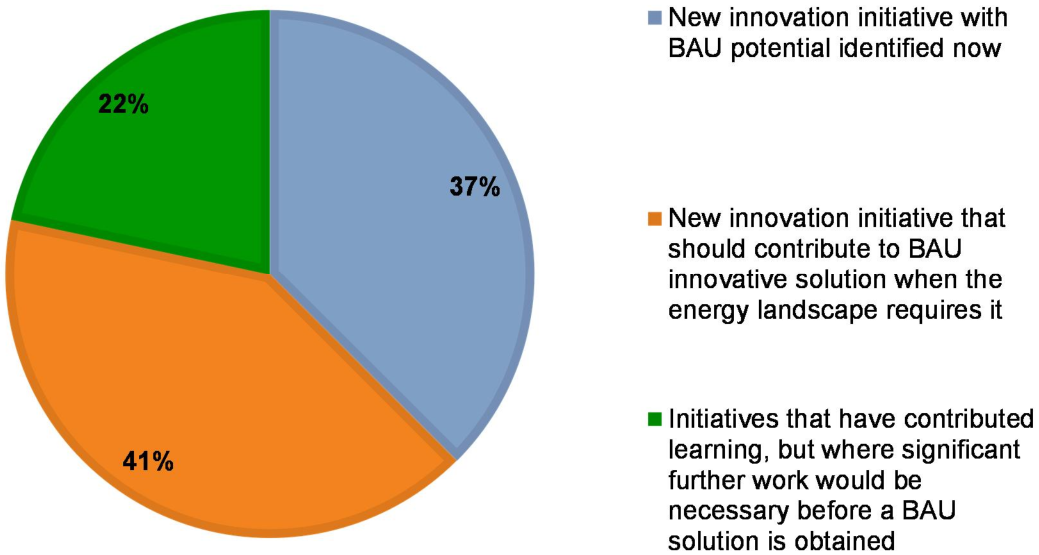
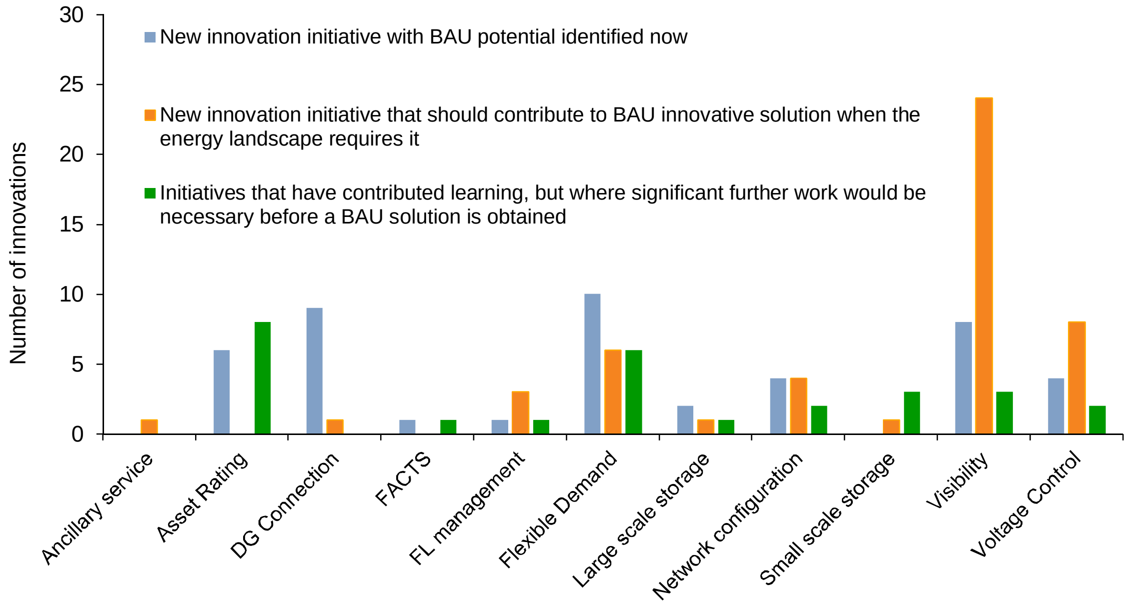


Figure 12 – Innovation initiatives by category and timing of BAU potential



4.4 The Success of the LCNF Scheme

This section looks more generally at the overall success of the LCNF. It is based on our independent view – drawn from a review and assessment of the responses from project partners and general industry parties regarding the success or otherwise of the LCNF.

4.4.1 Introduction

We sent out 157 questionnaires to project partners, stakeholders and other industry parties asking them about the success of the LCNF. 28% of questionnaires were returned, and an additional 4% replied to say they would not be responding. We received a wide range of views from the LCNF expert panel, academics, manufacturers, IT, data and communications specialists, consultants, energy suppliers and energy management companies.

A commentary on the project partner questionnaire responses is given in Annex B and for general industry respondents in Annex C. The following sections have been drawn from an amalgamation of the responses received.

4.4.2 Observations from questionnaire responses on the success of the LCNF

This section considers the questionnaire responses on the success of the LCNF to meet its objectives.

4.4.2.1 Have the DNOs been incentivised to include innovation as part of their core business?

Questions:
Do you believe that the LCNF has met its objective in incentivising the DNOs to include innovation as part of their core business?

To what extent do you believe that the LCNF projects would have occurred without the LCNF?

Over 50% of respondents said that the LCNF as met its objective, with 32% holding the view that it is 'work-in-progress' and 11% believing that the LCNF had not met its objective. The remaining respondents did not know or did not answer the question.

Just over half (53%) of respondents thought that the projects would not have occurred without the LCNF, with 22% saying LCNF had accelerated the innovations. 17% thought that a small number of projects might have occurred without the LCNF.

Questionnaire responses to these questions include references to broader organisational issues associated with making innovation part of the core DNO business – such as the creation of the Future Networks Groups. Responses also included views on the range of projects undertaken and opinions about what is likely to have happened without the LCNF. A summary is given in Figure 13.

Some of the views and opinions we have gathered from the project partners and other industry parties about the status of innovation within the DNOs before LCNF relate to issues associated with fundamental business drivers (e.g. cost viability of a regulated company, risk profile etc.). Despite the IFI and Registered Power Zone (RPZ) incentives for small scale innovation, some respondents described the DNO attitude to innovation prior to LCNF as tending to be somewhat negative. Some respondents felt that active network management and demand-side response would not be possible without the LCNF. On the other hand the respondents did note that disruptive technologies would have necessitated some technical advances in the smart area anyway.

Figure 13 – DNO adoption of innovation: summary of questionnaire responses

Future Networks groups created	▪ Culture change away from previous conservative attitude, now senior level support ▪ innovation support ▪ Innovation included in business plans, questionable if benefits of innovation are fully reflected in business plans ▪ Gradual change, core mind set needs to change ▪ Emphasis on business roll out and exploitation needed
Range of projects	▪ Range of new technologies ▪ Engagement with new stakeholders ▪ New business practices - ANM, Alternative connections, demand profiling, demand response ▪ Trials based around existing assets, in circumstances close to BAU
Without LCNF	▪ No LCNF = no innovation ▪ Low TRL level not undertaken by DNOs ▪ Fundamentally different to traditional investment projects ▪ Competitive regulated businesses would be adverse to knowledge sharing and lead to duplication of learning

4.4.2.2 Has LCNF met its objective of helping the DNOs move towards a low carbon business?

Questions:
Do you believe that the LCNF has met its objective of helping the DNOs move towards a low carbon business whilst maintaining security of supply and delivering value for money to customers?

Half (50%) of respondents thought that the LCNF has helped DNOs move towards a low carbon business whilst maintaining security of supply and delivering value for money to customers, just over a third (36%) thought that this was ‘partially’ true and 6% disagreed.

Questionnaire responses to these questions include views on how the LCNF fits within a regulated business, the range of projects undertaken and the pros and cons of the competitive nature of the scheme. A summary is given in Figure 14.

Figure 14 – DNO move to low carbon business: summary of questionnaire responses

Business Practice

- DNO business aim is to achieve return on investment whilst delivering statutory obligations
- LCNF assisted with RIIO transition. RIIO ED1 plans recognise efficiency and value gained from innovation
- No market control over DG, DG customers benefit not DNO
- Benefits from some projects will accrue in the future
- Beneficial for GB

Range of Projects

- Discrete projects – lack of overall vision
- Not all projects suitable for GB rollout
- Innovation carries risk – new thinking enabled
- Innovation is long term by nature
- Challenging time frame – smart meter roll out not complete

Competition

- Hinders true collaboration and sharing
- Hinders environment where failure can be discussed
- Ensures well planned projects, robust business case

4.4.2.3 Has LCNF met its objective of helping the DNOs move towards a low carbon business?

Questions:
Do you believe that the LCNF has met its objective of helping the DNOs facilitate low carbon and energy saving initiatives?

39% of respondents said they did believe that the LCNF has met its objective of helping the DNOs facilitate low carbon and energy saving initiatives, with 39% saying partially and 3% saying no.

The responses are summarised in Figure 15, with the level of engagement between DNOs, customers and partners being highlighted as unprecedented. The energy saving target was challenged as being something for wider consideration than the DNOs alone as it the mainly falls in the demand side.

Figure 15 – Low carbon and energy saving: summary of questionnaire responses

Engagement	▪ Unprecedented engagement between DNOs, customers and partners ▪ DNOs engagement with customers should be via suppliers, aggregators, local authorities etc.
Energy Saving	▪ Some energy saving projects looking at customer efficiency ▪ Difficult measure -should be considered across the whole value chain - whose responsibility is energy saving - customers/ suppliers etc.
Low Carbon	▪ More low carbon projects covering DG connection and demand response - transport and heat ▪ Awareness of DNO challenges highlighted

4.4.2.4 Has LCNF met its objective in respect of dissemination of learning?

Questions:
Do you believe that the LCNF has met its objective dissemination of learning to facilitate roll out of successful trials?

Are you aware of learning being implemented from trials by other DNOs as well as their own?

Just over two-thirds (70%) of respondents were of the view that the LCNF has met its objective in regard to dissemination of learning. One fifth (20%) thought that this has been 'partially' achieved with no respondents thinking that the LCNF failed to meet this objective.

The responses were positive with respect to the project learning dissemination whilst making observations as to how the quality could be improved, and also the conflict between sharing knowledge in a regulated industry. Observations are summarised in Figure 16.

With respect to DNOs implementing learning from each other's trials, there was recognition that the more recent projects building on learning from the earlier projects and IFI projects. Some examples of project knowledge being used by other DNOs are as follows.

- storage knowledge;
- DSR learning (e.g. from LCL and FALCON);
- ANM learning to connect generation; and
- specific equipment deployment (e.g. phase shifting transformer from Flexible Plug and Play).

Figure 16 – Learning dissemination: summary of questionnaire responses

Range of media	▪ Documents/ videos/ webinars/ social media/ newsletters ▪ Best practice guides ▪ Events / conference papers/ LCNI/ journal publications ▪ ENA Smarter Network portal ▪ Knowledge exchange forums ▪ DNO R&D manager Working Group meetings facilitated by ENA to share information
Quality	▪ Availability and format of information varies across projects ▪ Third parties can be reluctant to share data ▪ Linkages and learning between projects not clear ▪ Less good at dissemination outside the DNO community ▪ Can be significant elapsed time before learning is disseminated
Competition / regulation	▪ Recognition of failure being positive - leaning needs to improve ▪ Balance between meeting LCNF obligations and protecting IP to gain efficiency edge ▪ Successive projects build on learning from previous projects
Implemen-tation of learning	▪ Easier to implement own learning ▪ Fast followers exposed to reduced levels of risk and time and cost savings when adopting learning

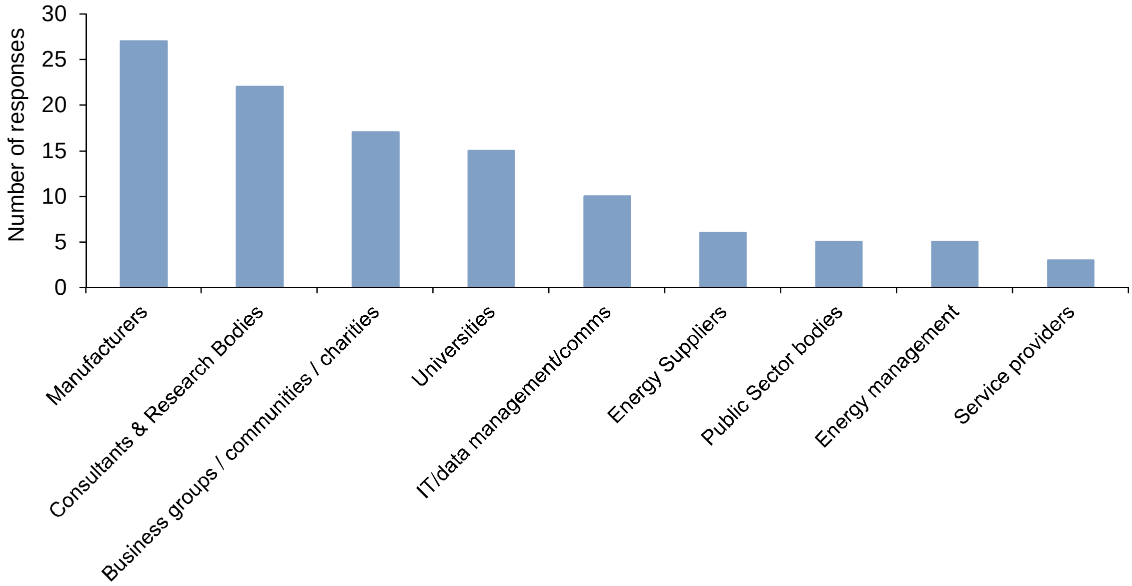
4.4.3 Project partner involvement and LCNF barriers

This section considers the questionnaire responses on the project partner involvement and identified barriers.

4.4.3.1 Project partners and stakeholders

Over 100 third parties and stakeholders have been involved with LCNF projects. These represent a large section of industry and include academics, manufacturers, the public sector, IT and communication specialists, consultants, service providers, energy suppliers, energy management companies, business groups, communities and charities. The numbers of organisations per sector is illustrated in Figure 17.

Figure 17 – Project partners and stakeholders: organisations per sector



The initial partner involvement in projects occurs in variety of ways. In some instances there is evidence that the DNO has been proactive and has approached third parties directly. In other instances the partners themselves have been proactive in engaging with the DNOs. An ENA portal has been developed and serves to increase awareness of the projects – as well as providing a means for requesting additional information.

4.4.3.2 Project partner collaboration

Questions:
Do you believe that the LCNF has met its objective of effective collaboration between the DNOs and project partners?

Are you aware of any barriers that may have discouraged project partner involvement?

In respect of effective collaboration 66% of respondents said that that the LCNF has met its objective of effective collaboration between DNOs and project partners, 23% said partially and 3% no. Barriers to project partner involvement were cited by 61% of respondents.

With respect to the selection of, range, skills and contribution from project partners a range of activities from the initial innovative ideas, planning through delivery to business roll out were highlighted as detailed in Figure 18. Barriers were around the requirement to demonstrate value for money which evolved during the early stages of the LCNF with the 2011 version 4 governance document requiring the project to have the potential to deliver net financial benefits to existing and/or future customers. Whilst demonstrating value for money is a commendable project management requirement it is not always straight forward to demonstrate in the context of innovation projects. There are a variety of reasons for this such as:

- specific expertise in respect of an innovative idea may lie with one, or few companies and hence competition may be difficult to achieve;
- the cost of the project is difficult to determine due to the uncertainty around it's innovate nature; and
- the uncertain energy landscape can make the creation of a robust business case challenging.

Whilst there was no direct mandate for project partner contribution, the governance document states that accessing additional funding will be looked on favourably and cites project partners who have an interest in the results of the project as an example as a source of such funding. It was felt by some respondents that the way this was interpreted at the project scoping stage and the benefit to the partner was not always clear.

The length of time a project partner may have to wait for payment milestones and to receive a share of the final successful delivery reward payment (which may be over 12 months), is difficult for small companies cash flow.

With respect to IP about half the project partner respondents felt that IP rights were treated appropriately within the LCNF. The issues identified by one quarter of respondents were about the standard clauses requiring participants to give up too much IP and the difficulties with sharing whilst not giving away background IP. This is generally more of an issue for SMEs some of whom consider that the default terms in LCNF and NIC are potentially restricting and that addressing IP correctly to achieve the most appropriate exploitation of IP is time-consuming.

A range of positive contributions from project partners have been identified at all stages of the projects – planning, delivery and roll out. It has been observed that there is a range in the level of engagement and practice with respect to partner management by DNOs and within DNOs and there is a need to consider and aspire to consistent best practice in this respect.

Figure 18 – Project partner barriers and contribution: summary of questionnaire responses

Range of parties	▪ Academics, manufactures, SMEs, energy suppliers, non traditional vendors - e.g. transport sector, consultants, stakeholders
Barriers	▪ Requirement to demonstrate value for money ▪ Requirement for project partner contribution – benefits to partners not always clear ▪ High level of risk (reputational and financial) to partners ▪ Appropriate treatment of IPR ▪ Ability of DNOs to explain challenges to partners and other stakeholders ▪ SMEs have limited funds for business development
Project Planning	▪ Initial innovation ideas ▪ Design ▪ Submission: authoring / reviewing / attending Ofgem meetings
Project delivery	▪ Contributing wider system knowledge / research ▪ Support to DNO businesses ▪ Solving challenges ▪ Business case modelling / development ▪ Data analysis / modelling / system support / tools & guides ▪ Knowledge dissemination
Roll-out	▪ Landscape dependent ▪ Important to prove methodology
Partnering skills	▪ Developed, but work in progress ▪ All partners need to be on track to deliver ▪ Partners can underestimate commitment required to fully deliver ▪ Pressure of Successful Delivery Reward Criteria vs innovation ▪ At times partners could be marginalised / not fully supported by DNO expertise ▪ Development of good practice in innovation project management and delivery would be valuable ▪ Guide for project partners would be useful – explanation of fund/ revenue ▪ Open engagement / clear communication essential

4.4.3.3 Project success and suggested modifications

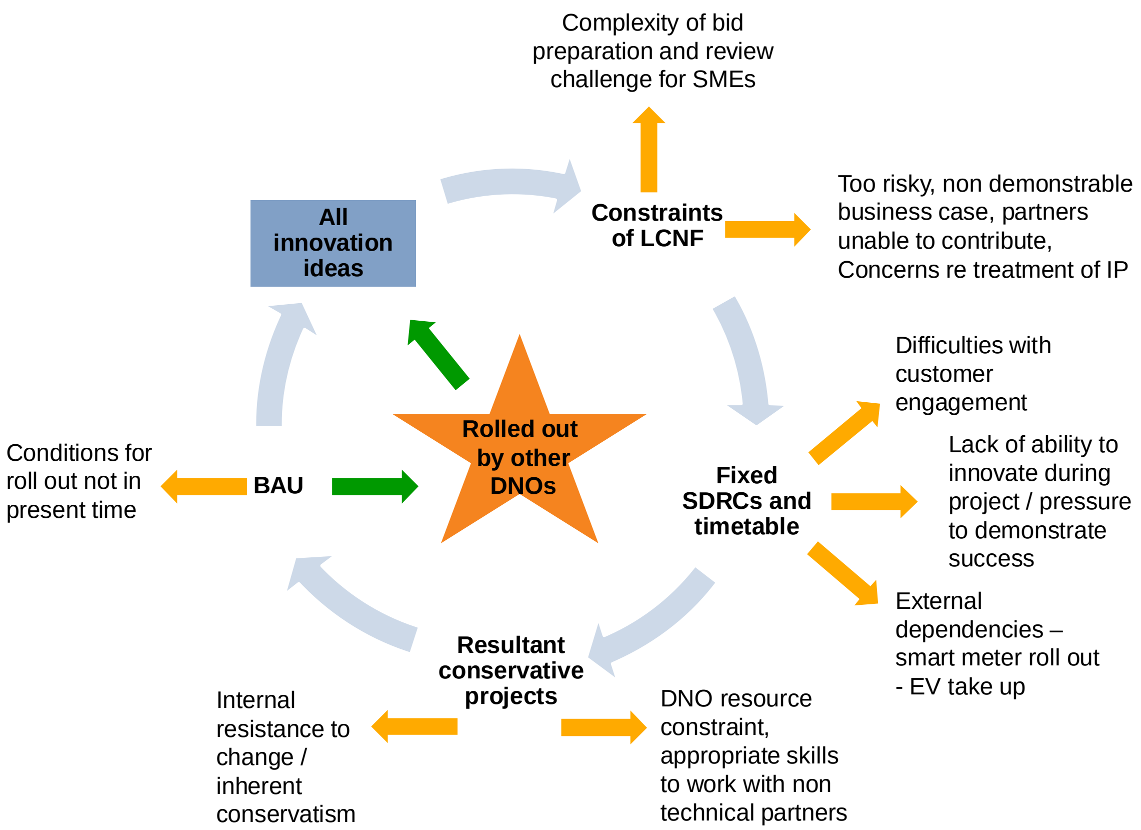
The project partners and the general industry respondents commented on barriers to innovation and suggested a range of modifications in respect of governance of regulated innovation schemes and their place in the energy sector.

Questions:
Are you aware of any barriers that may have affected the outcome of the project?

Barriers to project outcome were cited by 61% of respondents. Barriers to full innovation were noted throughout the project lifecycle associated with the initial governance constraints, the delivery constraints which are not ideal for innovation, and the existing

DNO capacity to undertake innovation as illustrated in Figure 19. Projects may not get rolled out into business as usual if the current landscape is not yet ready for them, for example demand side response projects.

Figure 19 – Identified life cycle barriers



4.4.3.4 Suggested changes to LCNF

Questions:
What would you change about the LCNF in retrospect?

The response to changes to the LCNF covered the immediate scheme governance and DNO regulation with a view to enabling innovation and the importance of fitting the LNCF into the overall GB energy vision. Specific points are detailed in Figure 20.

Figure 20 – Suggestions for changes to LCNF: summary of questionnaire responses

Governance	▪ Active management of risk – Risk/benefit/management/Ofgem awareness to encourage wider innovation ▪ Ideally the regulatory model should encourage DNOs to dedicate funds and resources to R&D on the basis that benefits would be shared equitably and proportionately between shareholders and consumers ▪ Simplified change request process ▪ Recognition that embedding new technology and business process in BAU is not trivial ▪ Present emphasis is on strategic integration of proven technology and commercial innovation – assistance to funding and business development challenge for start-ups to bring forward and develop innovative ideas at the lower end of the TRL spectrum ▪ Extend access to competition outside DNOs
Project direction and management	▪ Successful national Low Carbon Energy Strategy needs to exploit the synergies between energy vectors – include cross energy vector trials ▪ Overarching view needed of how innovation projects fit together to achieve common goals ▪ Ofgem should further commit to developing – innovation cultures – sector innovation capabilities – good practice and excellence in innovation – project delivery – exploitation ▪ Recognition of innovation benefit to GB plc

4.4.4 Effect of LCNF on private sector innovation and third-party access to LCNF funding

Questions:

Do you believe that LCNF has prevented, or otherwise discouraged, private sector innovation?

Do you think third party access to LCNF funding would improve the quality of innovation projects and if so why?

75% of respondents did not think that the LCNF has discouraged private sector innovation, with several respondents suggesting LCNF had encouraged it by providing an opportunity to demonstrate and prove technology on the DNO environment. 8% felt the LCNF has had no effect on private sector innovation. This question was not answered by 17% of the respondents.

Responses to the question about third party access to funding varied with 28% of respondents saying yes, 22% saying no and 36% having mixed opinions. Whilst third parties can currently lead projects with a host DNO, this question questioned the idea of undertaking projects without a DNOs direct involvement. The pros and cons of third party access to funding identified by responses are summarised in Table 13. A number of respondents felt that the involvement of a DNO, in some form, remains critical to the relevance and success of the project.

Table 13 – Third parties direct access to innovation : pros and cons

Pros	Cons
Third parties have numerous innovative ideas	May have excessive number of applicants
High level of innovation achieved by third parties	Host DNO needed
Third party skill sets are beneficial to the project	DNO experience essential – ensures project is addressing current challenges and outcomes are transferable to BAU
Could be a platform for information and project idea exchange	Access to DNO network needed for project validation
Small and Medium Enterprises (SMEs) benefit from support	Management of Intellectual Property Rights to ensure benefit to customers
Smart solutions do not always benefit the regulated DNO	Collaboration needed to avoid project duplication – wasted bidding effort

4.4.5 LCNF overview – scope and process

The project partners responded to a set of questions about the LCNF scheme in respect of communication of information about the introduction of the LNCF, the required criteria, the application process, the project selection process and Ofgem overall approach to innovation. A full summary of responses can be found in Annex B, with the main points being detailed in Figure 22.

A discussion was held with the academics about the scope for innovation in whole energy systems; i.e. those that cover gas and electricity, transmission and distribution. The consensus was that due to overlaps and synergies there could be a number of benefits to whole system energy analysis and innovation. Innovation projects could provide an opportunity to explore more holistic approaches to energy systems and encourage stakeholders to communicate on common areas. It was noted that stakeholders are not used to working together in this context and are not necessarily familiar with each other's specific challenges; hence options should be carefully considered, including the role (if any) of Ofgem and key stakeholders in determining areas of focus.

Figure 21 – LCNF scheme overview: summary of questionnaire responses

Initial information about LCNF	▪ Awareness of LCNF - range of media ▪ How to get involved - dependency on DNOs - could be cautious - commercial interests
LCNF criteria	▪ Generally appropriate ▪ IP issues ▪ Progression to focus on project outcome positive ▪ Measurement of carbon benefits important
Ongoing commun-ication from Ofgem	▪ Had to know where to look – Ofgem website/ daily bulletin ▪ Large volume of complex information ▪ Lack of flexibility and slow response to requested changes hindered projects ▪ Via DNO
Application process	▪ Mainly felt to be straight forward ▪ Level of detail in forms can be unrealistic at start of process
Project selection criteria	▪ Understanding of process has developed over life of scheme ▪ Feedback generally felt to be sufficient for unsuccessful projects
Ofgem and innovation	▪ Ofgem seen to value innovation ▪ Ofgem's commitment to developing innovation culture, organisational commitment, sector innovation capabilities, good practice and excellence would be valuable

4.5 Summary

This section has considered both individual project assessments, considered the roll-out of innovation initiatives into BAU and looked at the overall success of the LCNF scheme. This assessment has determined that the individual projects achieved high scores against the LCNF criteria and have all made technical and/or commercial contributions to accommodating DG and LCTs on the networks. It was noted that whilst individual knowledge dissemination has been good for the Tier 2 projects there is an opportunity to maximise the value of the learning by improved overall assimilation and improved Tier 1 dissemination information.

The uncertainty about the future take up of LCTs has been an underlying factor throughout the lifetime of the LCNF with some innovation initiatives being suitable for roll-out once a requirement or need has been identified for the delivery of the solution. It is estimated nearly 40% of the initiatives have been successfully rolled into BAU, with another 40% of initiatives being suitable for roll out once the energy landscape requires the solution. The remaining initiatives require further development before being suitable for BAU.

The following has been concluded from the qualitative review of the LCNF scheme which included consideration of the questionnaire responses:

- DNO adoption of innovation into core business is progressing;
- there has been unprecedented DNO engagement with customers;
- there have been wide ranging forms of dissemination;
- the collaboration with partners has generally been effective, but there is room for improvements to achieve best practice;
- consistent best practice project management and excellence in innovation is required, this includes active management of risk;
- the scheme is well-run on the whole, but where a project experiences challenges, it may be beneficial to the overall project outcome if Ofgem is able to engage with the project team to try to reach a quick resolution;
- the benefits from the projects may not always be directly aligned with the requirement of DNOs to move to low carbon business;
- there are barriers that affect the achievable level of innovation and success;
- there are barriers that affected project partner involvement;
- there is no overall low carbon vision across the innovation projects;
- high-level overview and co-ordination of the individual projects is required to ensure alignment with the overall direction of the whole energy industry;
- energy-saving should be considered in the context of the broader energy industry and across the whole value chain; and
- DNO experience and involvement likely to be important if projects are to be undertaken by third parties.

5. QUANTITATIVE ASSESSMENT OF THE LCNF

Delivering net financial benefits to existing and future customers was one of the key criteria for the original assessment of LCNF project applications. This has also been used as important criteria for the quantitative assessment of the LCNF stimulus, and is the subject of this section of the report.

5.1 Introduction

The aim of the quantitative evaluation is to understand the cost and benefits of the LCNF – both to the electricity network, and to the wider economy. We have attempted to estimate whether the benefits arising from the LCNF projects – both now and in the future – justify the resources and the financial commitment associated with project delivery.

However, the inherent uncertainty associated with understanding future benefits has been magnified by the fact that the LCNF projects are testing innovative concepts and novel ideas which, by their very nature, are uncertain. This leads to a number of challenges associated with monetising and comparing the benefits arising from the projects. For example, there are significant differences between the projects, both in terms of size and scope, as well as any misalignment between the specific aim of an individual project and the magnitude and direction of the perceived benefit. This uncertainty means that the calculation of financial and carbon benefits is far from straightforward.

It is also important to note that this evaluation comes at a very early stage in the roll-out of the LCNF project deliverables. Whilst the majority of the projects have been formally completed, in many cases the ideas, solutions and innovations are only just starting to be rolled out into normal business practices (see section4.3). And even where an innovation has been rolled-out into business as usual, in some cases it may take many years, and require fundamental changes in the energy market (e.g. electrification of heat and transport), before potential benefits will fully materialise.

It is therefore important that the quantitative values presented in this section should not be considered detailed projections of the LCNF scheme benefits, rather they should viewed as an estimate of the potential benefits and considered in the context of the wider evaluation.

5.2 Approach to the assessment

The evidence for our quantitative assessment is based on the DNO responses to our questionnaire. Through the DNO questionnaire we have quantified the costs and benefits (where applicable and practicable) associated with the LCNF projects. In addition to the benefits identified by the DNOs in relation to projects, our assessment has also included the costs associated with the implementation and operating of the scheme:

- **scheme implementation and operating costs:** this covers the cost of administering the scheme. These are the cost borne by Ofgem through the need for additional staff, external advice etc.
- **costs associated with project funding:** the actual cost of the LCNF projects; e.g. how much funding was granted by Ofgem to support the projects. This category also includes costs faced by the DNOs that were not covered by the LCNF. This includes an estimate of the cost incurred in preparing submissions (where applicable), including those submissions that were not successful.

- **current financial and CO2 benefits from the funded projects:** Where possible we have identified financial or CO2 benefits that have already occurred as a result of the LCNF. For this evaluation work we have defined the 'current benefits' as being those up until 31 March 2016.
- **future financial and CO2 benefits from the funded projects**: Given the uncertainty associated with future innovation, we have only monetised the potential benefits where the results are identifiable and credible. For this evaluation work we have defined 'future benefits' as being those that accrue between 1 April 2016 and 31 March 2031 (the end of the RIIO-ED2 period)[46].

5.2.1.1 Analysing the data

Given the uncertainty associated with measuring the potential benefits associated with innovation, we have discussed above, we have only monetised the potential benefits where we believe the results are robust and credible and can be defended.

Following receipt of the information from the DNOs we have undertaken analysis and validation of the results. Given the nature and stage of the LCNF projects there are no independent sources of information available by which to verify the quantitative data. As a result, our analysis has been undertaken based on a review of other DNO submissions, for example this includes the reports published as part of the LCNF process and benchmarking between comparable projects. Specifically this process has included:

- cross-checking the results against other publically available data, such as project 'Close Down' reports and bid submission, to make sure that the estimated benefits had consistency;
- ensuring consistency within, and between, the DNO submissions. For example we looked at LCNF projects with similar innovation initiative to check for any major difference in the benefits estimated; and
- analysing the results to understand the different types of initiative being investigated by the LCNF projects. In doing this we drew on the academic classification system developed by The University of Strathclyde in its report on the LCNF[16].

Finally, we spoke individually with each of the DNOs to resolve any questions we had on the original information provided. During these discussions we resolved a number of potential issues[47] and through the clarifications we were able increase the robustness of the information of the information provided. We are reasonably comfortable with the veracity of the data provided by the DNOs – recognising that these numbers would change if the DNOs had more time to undertake a more comprehensive assessment.

5.2.2 Assumptions for the quantitative assessment

Due to the uncertainty associated with the data our aim has been to keep the quantitative analysis as simply as possible and to avoid making spurious assumptions and undertaking analysis for which we have no basis. Our assumptions on the data are provided below:

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46 This assessment period is, in general, shorter than the assessment period used by DNOs in the project closedown reports.

47 For example we identified examples of double counting of benefits between projects and differences in the potential benefits between the questionnaire response and other publically available reports.

- **discounting**: A key simplification in our analysis is our decision not to discount the estimated value of the future quantitative benefits. The format (and quality) of the data we received was varied and, while some data was provided on an annual basis, the majority was not. In most instances this is a result of DNO uncertainty associated with *when* the future benefits are likely to occur. We have therefore concluded that there would be little justification (without making unsubstantiated assumptions regarding the data) in applying an artificial time profile to these benefits. Consequently while we acknowledge these quantitative benefits will occur sometime during the assessment period[48] we have not applied a discount the estimated future net benefits over time.

  Notwithstanding our view set out above, and for illustrative purposes only, we have undertaken sensitivity analysis to calculate the Present Value of the estimated future financial net benefits. This aims to give a sense of the difference that discounting could make to the results. In doing this sensitivity analysis we have assumed a linear distribution of the benefits over the assessment time period and applied discount rates of 3.5% and 4%. This assessment is presented in Section 5.3.4.2.

  As a result, the estimated financial benefits presented in this report should be considered non-discounted real 2015 money unless stated otherwise.

- **inflation**: We have converted all of the costs and estimated benefits to 2015 money to aid comparison – a summary of the inflation rates used for this conversion is provided in Table 14 below. Historic inflation rates are based on CPI.

Table 14 – Annual inflation rates (real 2015 money)

Year	UK Inflation rate
2012	2.8%
2013	2.5%
2014	1.4%
2015	0.05%

Source: Inflation.EU, and Pöyry analysis

5.3 Financial results

In this section we present a summary of the costs and estimated benefits of the LCNF projects based on our assessment outline in Section 5.2. All financial costs and benefits are presented in *real* 2015 money.

5.3.1 Costs

In our evaluation, the ‘costs’ associated with the LCNF relate, not only to the costs faced by Ofgem in the administration and operation of the scheme itself, but also the cost of project funding, and the contributions by the DNOs and other project partners. The cost

48 Between 01 April 2016 and the end of the RIIO-ED2 period (31 March 2031).

associated with operating the scheme is minor compared to the actual project costs The cost to Ofgem of implementation and operating the LCNF is estimated to be £1.5m [49].

The project costs for Tier 1 and Tier 2 projects have been calculated at approximately £275m. Tier 2 projects have accounted for the majority of this cost at £245m, while the funding of Tier 1 projects was approximately £30m[50].

5.3.2 Benefits

In our evaluation, the 'benefits' associated with the LCNF include all benefits associated with each of the LCNF projects with the exception of the carbon reduction benefits. We have assessed carbon savings separately and the results are presented in Section 5.6. In our assessment we consider both *current* benefits and potential *future* benefits[51].

The range of estimated benefits we present in this section are not formal 'projections'. We have estimated the range of benefits on a best endeavours basis based on the DNO responses to our questionnaire. This has included our own independent scrutiny and interrogation of the response data and the results. We recognise that this estimation of the range of quantitative benefit is made at a point in time and that this range could change significantly if, and when, more information is made available through DNO roll-out of these projects into business as usual.

As set out in Section 5.2.2, we have not discounted the estimated future benefits. Had the estimated benefits been discounted then they would be lower - depending on the discount rate and the assumption around the timing of the expected future benefits. To consider this impact, and give a sense of what difference discounting could make to the results, the Present Value of the estimated future financial benefits is set out in Section 5.3.4.2.

5.3.2.1 Nature of the benefits

In addition the nature of the financial benefits differ depending on the specific LCNF project, and the particular innovation initiative being trialled. Table 15 provides a summary of the types of financial benefit considered.

Table 15 highlights that many of the innovative initiatives have the potential for multiple financial benefits. For example, the connection of DG may give rise to benefits which can include the following.

- avoided network connection costs;
- reduced electricity losses;
- enhanced security of supply;
- provision of ancillary services and demand-side response; and

49 We have not included any potential costs that would accrue to parties not directly involved in the LCNF.

50 These are gross costs and so do not include contributions from DNOs and project partners. It includes both Tier 1 and Tier 2 projects.

51 Both the current and future benefits are based on the DNO questionnaire submissions. The future financial benefits provided by the DNOs are *net benefits*, that is, they take account of any costs associated with the roll-out of the innovations. In many cases the costs associated with project roll-out replace existing business as usual costs and so additional costs associated with rolling-out the LCNF projects are likely to be comparatively small, or even zero.

- deferral of network reinforcement.

The benefits associated with the connection of DG can be broad-ranging and is contrary to many other innovation initiatives which are more likely to target a specific need on the DNO network.

5.3.2.2 Exogenous benefits

Some of the benefits listed in Table 15 accrue to non-DNO parties; that is, some LCNF projects have beneficiaries beyond the DNO and, in some cases, beyond the DNO connected customers – impacting, for example, on the delivery of other Government policy such as security of supply. This is a critically important aspect of the scope of the cost-benefit analysis undertaken as part of the evaluation work.

Table 15 – Financial benefits

Financial benefit	Initiation categories
Reduced connection costs	DG Connection
Reduced network management costs	Asset Rating, Voltage Control, FL Management, Network Configuration, Visibility
Reduced electricity losses	DG Connection, Flexible Demand, Large Scale Storage
Security of supply[52]	DG Connection, Flexible Demand, Large Scale Storage
Provision of ancillary services/Demand-side response	DG Connection , Voltage Control, Flexible Demand, Large Scale Storage
Deferral of network reinforcement	DG Connection, Asset Rating, Voltage Control, Flexible Demand, Large Scale Storage
Improved asset management	Asset Rating, FL Management, Network Configuration, Visibility
Improved network reliability	Network Configuration, Visibility

5.3.2.3 Value of LCNF benefits

We have defined the 'gross' benefits as being the sum of all benefits from each of the LCNF projects, this includes both the benefits accruing to the DNO and the exogenous benefits described above in 5.3.2.2.

Based on the assessment of individual projects the estimated gross benefit of the LCNF – including *current* as well as *future* benefits – ranges from £1.8bn to £2.4bn, this is presented in Figure 22. The range reflects the DNO uncertainty in the exact level of benefits associated with the innovation projects. This estimate is also based on the

[52] Security of supply reducing GB dependence on imported primary energy.

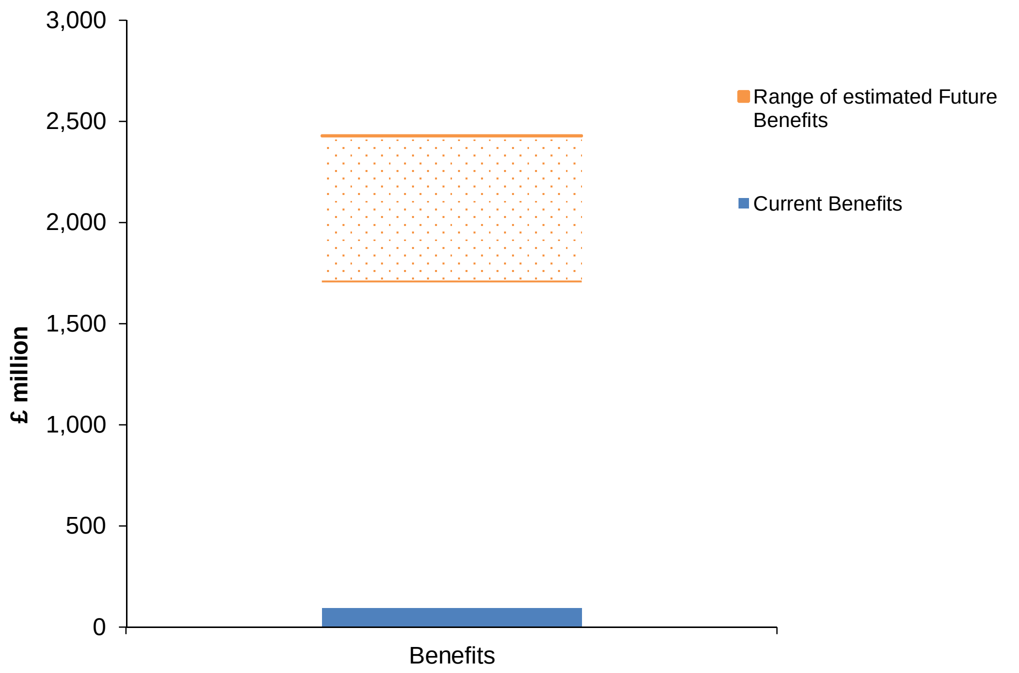
assumption that the innovation benefit is limited to the DNO's own network (unless a second DNO has already indicated it will take forward a project as a 'fast follower'[53]) – i.e. this does not include benefits accruing to DNOs other than the project lead DNO.

The potential increase in benefits associated with innovation being adopted by other DNOs – i.e. those beyond the 'host' DNO – is considered further in terms of 'scaling benefit' in Section 5.3.3.

Our quantitative assessment of the LCNF benefits include both *current* benefits and *future* benefits. This segregation of benefits has been designed to enable us to better understand whether LCNF-driven innovative initiatives are making their way into the DNO business as usual activity. Based on this assessment, Figure 22 shows that the *current* benefits (i.e. those to 31 March 2016) are estimated to be £96m – which is equivalent to approximately one third of the total funding.

Future benefits are estimated to be between £1.7bn and £2.3bn.

Figure 22 – Estimated benefits



Source: GB DNOs and Pöyry / Ricardo analysis

5.3.3 Scaled results

The estimated benefits presented in Section 5.3.2 are based on the assumption that the innovation from LCNF projects is only taken forward into business as usual by the 'host' DNO – i.e. on the network of the DNO who trialled the project. However, one of the key aims of LCNF (as set out in Section 4) is the knowledge dissemination and associated learnings between the GB DNOs. This learning ought to enable a DNO to take forward

53 At least one DNO identified in its questionnaire response that it is in the process of rolling out projects which have been developed by another DNO.

successful projects on their own network which may have been originally trialled in another DNO area.

This expectation that some innovative techniques, initiatives and approaches can, and will be shared enables some of the estimated LCNF project benefits to be scaled to a GB-level. It is recognised, however, than some project outcomes have a higher degree of 'scalability' than others – in fact, some project outcomes are DNO-specific and may have limited or no value to other DNOs. This is often the case in the initial pilot or trial phases where LCNF projects may be addressing an issue that is unique to one DNO network.

It is also important to recognise that in some instances, LCNF projects are broadly looking at different ways to address the same challenge or achieve the same outcome. In these cases it is highly unlikely that *both* approaches would be rolled-out across GB.

To understand the extent of the additional benefit from scaling, we have reviewed each individual LCNF project and assessed whether or not we believe it has the potential to be extended to other DNO areas. In doing this we have taken account of both the technical specification of projects (e.g. can it be transferred to another DNO network), and also the potential for project overlap. We have then scaled the results based on the number of connected customers[54]. This assessment is based on the estimated financial net-benefits provided by the DNOs based on their own network, and does not, therefore, include the specific *costs* associated with deploying and implementing these innovations on the networks of other DNOs. We do accept, however, that there will be a difference in costs associated with this scaling, but is unclear as to the magnitude of these costs. For example, while replication of learning can sometimes be difficult due to the unique characteristics of different distribution networks, the learning developed through the LCNF projects can, in some cases, reduce implementation costs for other DNOs.

We estimate the potential GB-scaled benefit to be between approximately £7bn and £11bn. This is shown in Figure 23.

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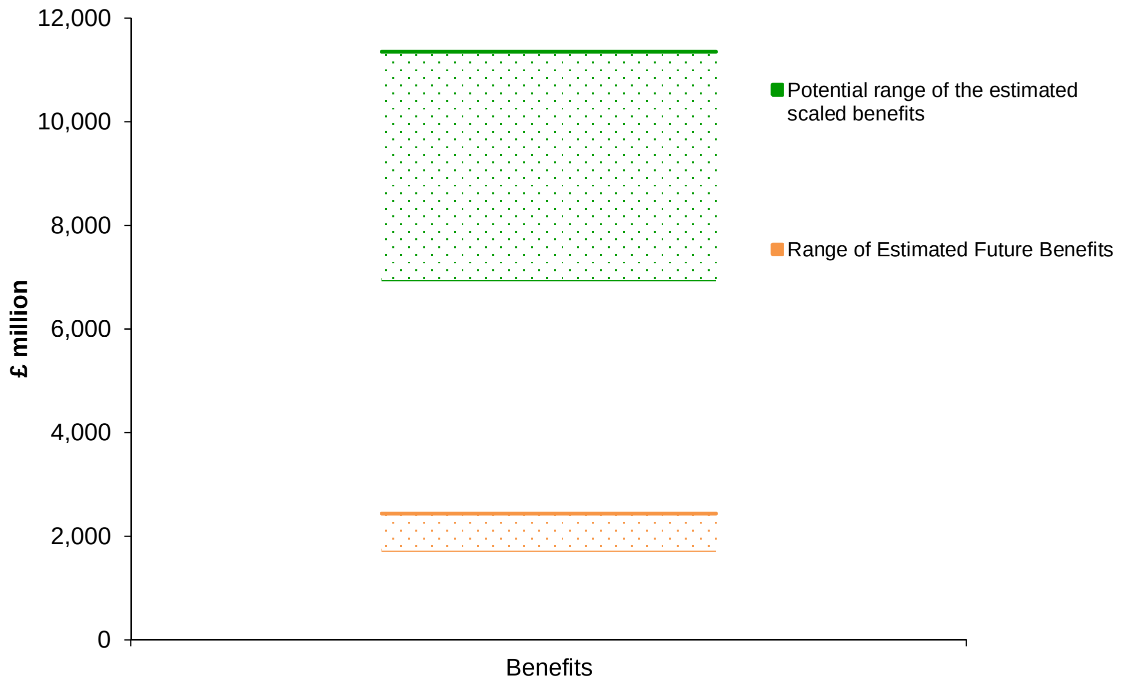
54 There is uncertainty associated with the estimated of (future) scaled benefits – principally because they depend on each of the DNOs adopting learning from other projects. Given this uncertainty, we have attempted to keep the analysis simple by scaling the benefits based on the connected customer numbers. A part of this work we considered a range alternative basis for scaling (e.g. RAB, network length) however we decided that this method was the most logical and straightforward. This methodology was discussed with the DNOs.

Figure 23 – Estimated scaled benefits



Source: GB DNOs and Pöyry / Ricardo analysis

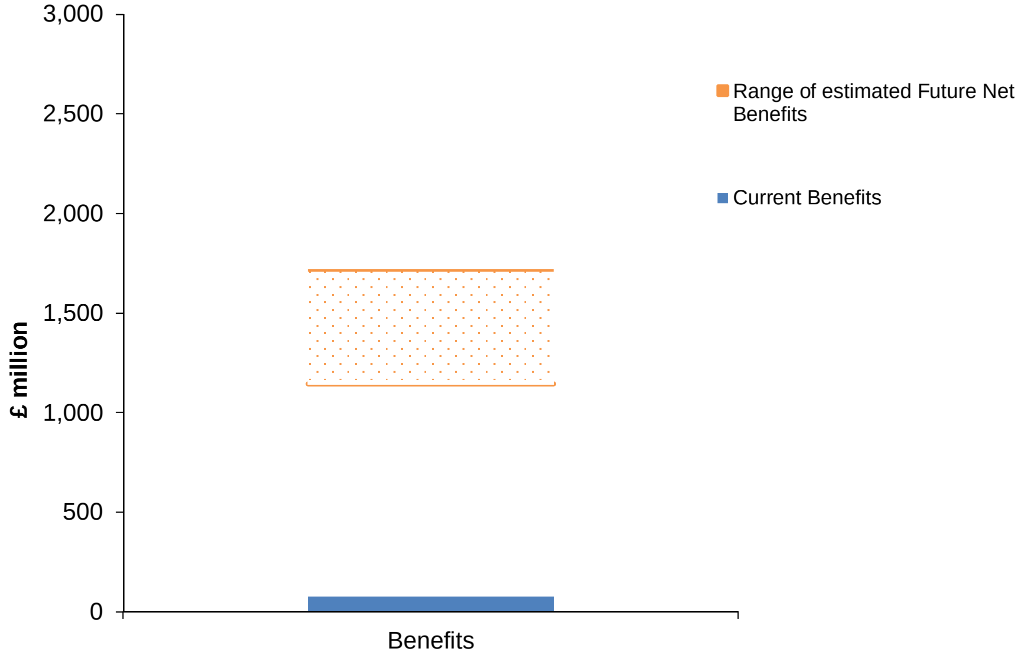
5.3.4 Net benefit

Figure 24 presents an assessment of the estimated net benefit from the LCNF. The net benefit takes account of the costs highlighted in Section 5.3.1 together with our estimate of the counterfactual position – where net benefit is equal to the gross estimate of the value of the benefits minus the cost and adjusted for our assessment of the counterfactual position.

As we set out in Section 2.5.4 we have sought to identify an appropriate counterfactual through a qualitative process, supported by an assessment of the benefits identified by the DNOs in their responses to our questionnaire. Based on this assessment we have estimated the counterfactual to be around 20% of the total (gross) benefit.

We estimate that the net benefit, taking account of the project costs and the counterfactual position (20%), is in the order of £1.1bn to £1.7bn.

Figure 24 – Net benefit associated with the LCNF



Source: GB DNOs and Pöyry / Ricardo analysis

5.3.4.1 Sensitivity on the counterfactual

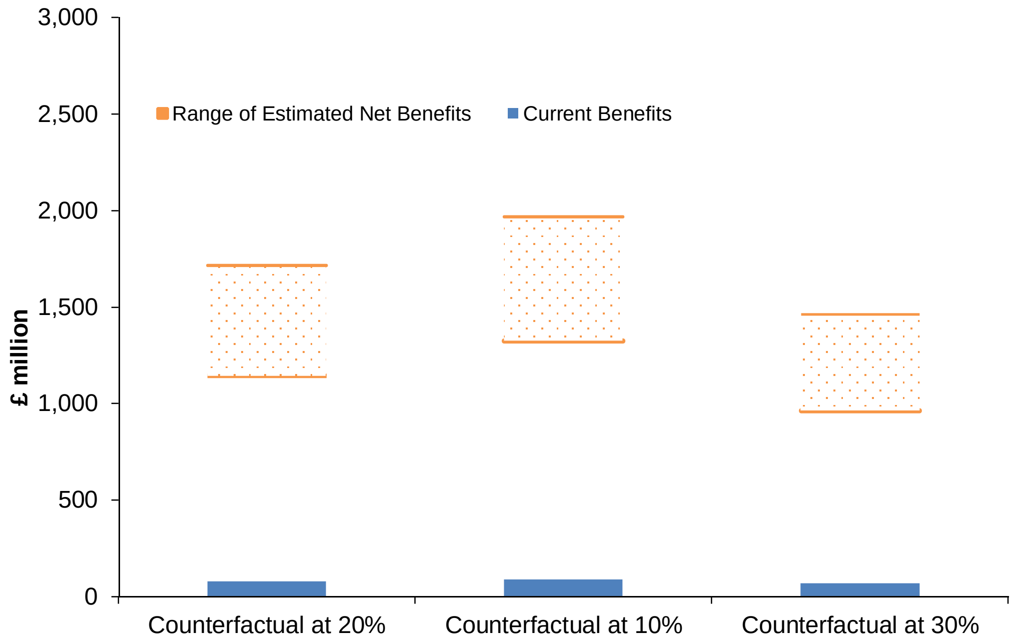
As we discussed in Section 2.5.4, in addition to the uncertainty surrounding the benefits there is also uncertainty in relation to the counterfactual. For example, when described in terms of the benefits associated with the connection of DG, our 20% counterfactual assumption suggests that the majority of DG connections and, therefore, a significant proportion of the reported current benefits, would have occurred anyway and without support of the LCNF.

To highlight the impact of this uncertainty we have undertaken sensitivity analysis around the 20% level when estimating the net benefits. This sensitivity analysis shows the impact on the value on the net benefits of an increase to a 30% counterfactual level, as well as a decrease to a 10% counterfactual level:

- counterfactual at10%: For example this may be appropriate if the cost of connecting DG is thought to be more expensive than in the base case – perhaps due to a lower level of innovation in connection methods – which may lead to fewer generators connecting and delivering benefits.
- counterfactual at 30%: For example, other market incentives encouraging the connection of DG, such as the improved business case through subsidies for DG, led to the DNOs connecting more generation than in the base case and encouraged DNOs to look at some of the other smart solutions for network operation.

This assessment is presented in Figure 25.

Figure 25 – Net benefits with counterfactual sensitivity



Source: GB DNOs and Pöyry / Ricardo analysis

The reduction in the counterfactual to 10% will lead to an increase in the estimated benefits, with a range of £1.3bn to £2bn. A counterfactual of 30% will result in a decrease in the estimated net benefits, with a range of £0.9bn to £1.4bn.

5.3.4.2 Sensitivity on the impact of discounting

Our central evaluation does not attempt to discount the estimated future financial benefits associated with LCNF projects. The reason for this is explained in Section 5.2.2. However, to give a sense of the impact discounting could have, we have undertaken sensitivity analysis on the 'Estimated Future Net Benefits'. This analysis is presented below.

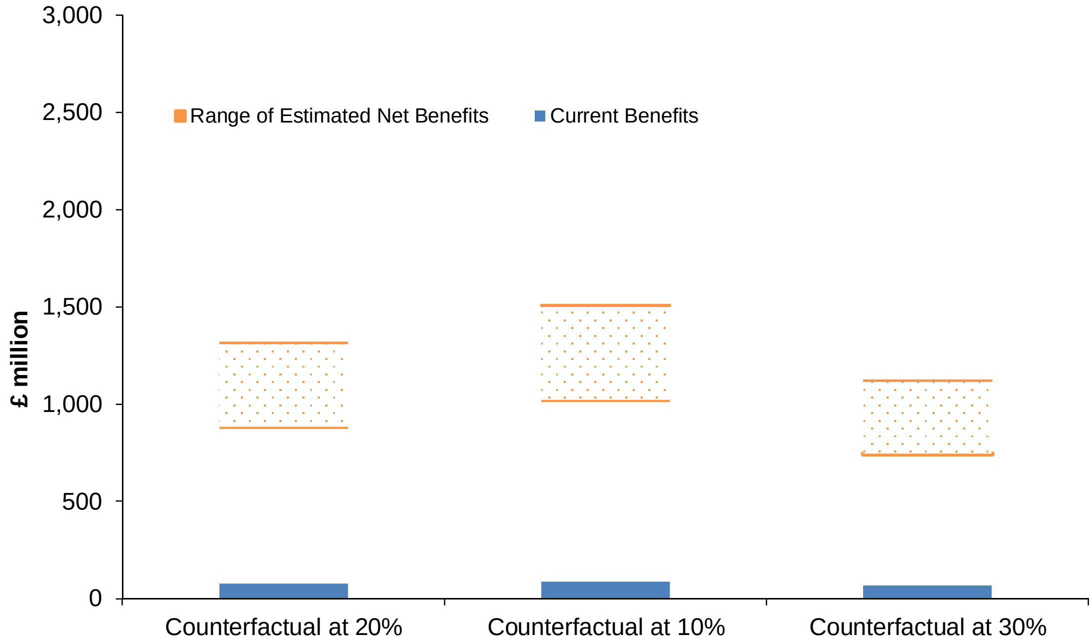
To show the potential magnitude of the impact of discounting the estimated future net benefits, we have presented, for illustrative purposes, the present value of the estimated future financial benefits. Although we do not know the precise profile for when, during the assessment period, these estimated future net benefits will occur, it is clear that they will most likely occur over a multi-year period. Therefore, for this sensitivity analysis we have assumed a linear distribution of the benefits over the assessment period.

To test the sensitivity of the estimated future financial benefits to the discount rate we have presented the results using two different discount rates. In Figure 26 we have discounted the estimated future net benefits at a discount rate of 3.5% - this is the recommended HM Treasury rate for discounting as set out in the HM Treasury Green Book[55]. In Figure 27, we have applied a discount rate of 4%. This is broadly equivalent to

55 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf

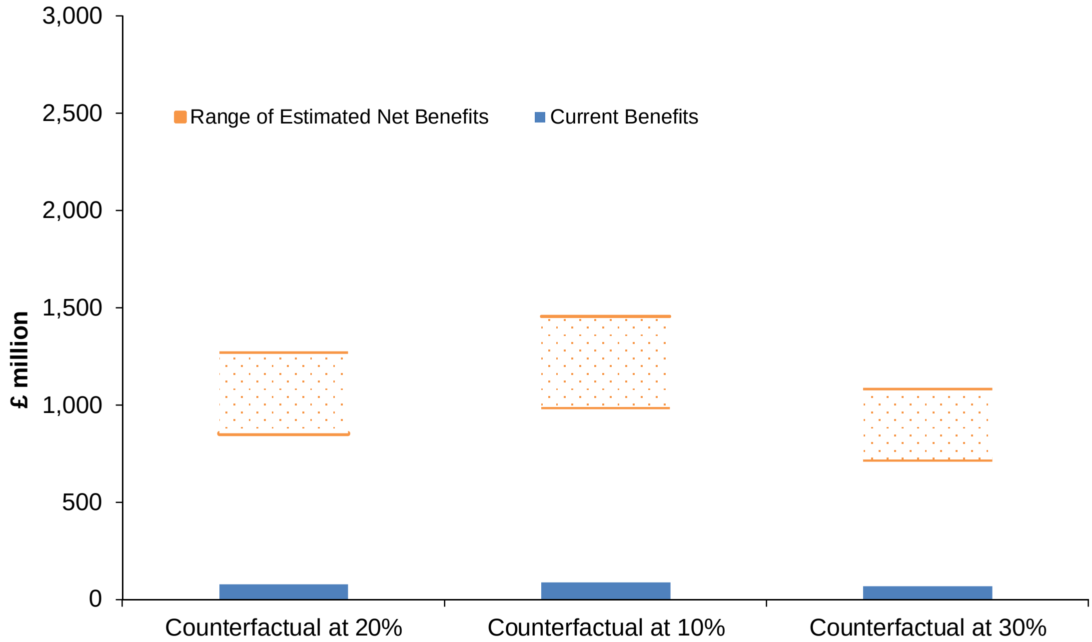
the average allowed pre-tax Weighted Average Cost of Capital (WACC) assumed for RIIO-ED1 fast tracked and slow tracked companies.

Figure 26 – Present value of the net benefit associated with the LCNF (3.5%)



Source: GB DNOs and Pöyry / Ricardo analysis

Figure 27 – Present value of the net benefit associated with the LCNF (4%)



Source: GB DNOs and Pöyry / Ricardo analysis

These results are further summarised in Table 16. This table shows the potential reduction in the estimated future net benefits resulting from discounting. For example, at a 3.5% discount rate the estimated future net benefits would be approximately 25% lower than the non-discounted estimated future net benefits.

It is important to note that the actual level of the estimated future net benefits will depend on both the discount rate and the assumed timing associated with the future expected benefits.

Table 16 – Comparison of discounted and non-discounted results at the 20% counterfactual (£m)

	Estimated Net Benefits (lower)	Estimated Net Benefits (Upper)
Non-discounted	1,000	1,700
Discounted at 3.5%	800	1,200
Discounted at 4%	780	1,190

Source: GB DNOs and Pöyry / Ricardo analysis

5.4 Transition to business-as-usual

In Sections 5.4.1 and 5.4.2 we examine the estimated benefits based on the likelihood of transition into DNO business as usual (BAU). This assessment draws on the BAU analysis presented in a recent academic report[16].

The aim of this analysis is to highlight the technology types which are most likely to be incorporated into BAU in the DNOs in the near term. This could help guide future decisions on the award of innovation funding between different types of projects, based on the timing (and magnitude) of the expected benefit.

It is important to note that we have not used the 'BAU scoring' presented in this section to weight the estimated benefits, and our reasons for this approach are outlined below:

- the data provided by the DNOs already includes an implicit weighting of the estimated benefits during this assessment period. For example the DNOs did not provide estimated benefits for projects they believed would not be implemented during the assessment period of this study – while the estimated benefits for some projects are assumed to occur only in the later part of the assessment period, indicating that the DNO does not believe the technology is ready for deployment at this time; and
- further, as part of this study we have not undertaken the necessary technical and financial assessment of each individual project that would be required to enable us to calculate an accurate alternative weighting.

Consequently we have not undertaken any additional weighting of the estimated benefits to account for the scoring outlined in this section.

5.4.1 Types of innovation

As part of the work, and as a separate exercise to the quantitative evaluation described above, we have also considered the question of the likelihood that LCNF projects will transition into DNO BAU. This may depend upon the type, or category, of innovative initiative. Some initiatives have been designed to address immediate challenges – the connection of increased levels of renewable DG for example. Therefore it cannot be assumed that, where an initiative is currently thought to have a low probability of moving into BAU, this is indicative of the failure of a project. For example, extracting the full value of other innovation trials may require further policy changes, R&D or wider sector developments – such as electric vehicles or storage. A summary of these timing issues is represented in Figure 28 below.

Figure 28 – Benefits to different parties over time

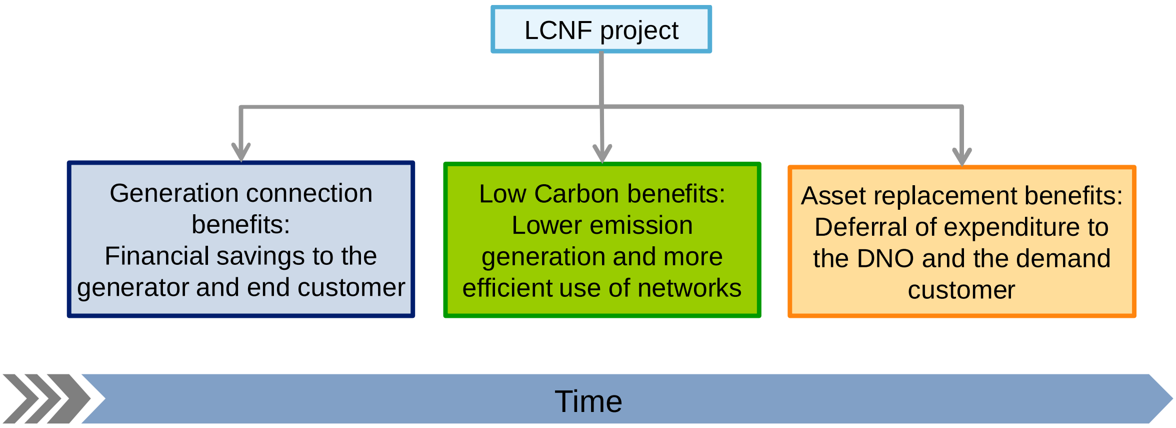


Figure 29 shows the various categories of innovation (as per Table 17) against the probability of adoption into business as usual. This probability assessment draws on the BAU analysis presented in the recent, previously referenced, academic report[16]. A summary of the BAU scoring basis is provided in Table 17.

Table 17 – BAU scoring scale

Strong Evidence Against		Indications Against		Inconclusive	Indications For		Strong Evidence For	
-4	-3	-2	-1	0	1	2	3	4

A Review and Synthesis of the Outcomes from Low Carbon Networks Fund Projects, The University Strathclyde

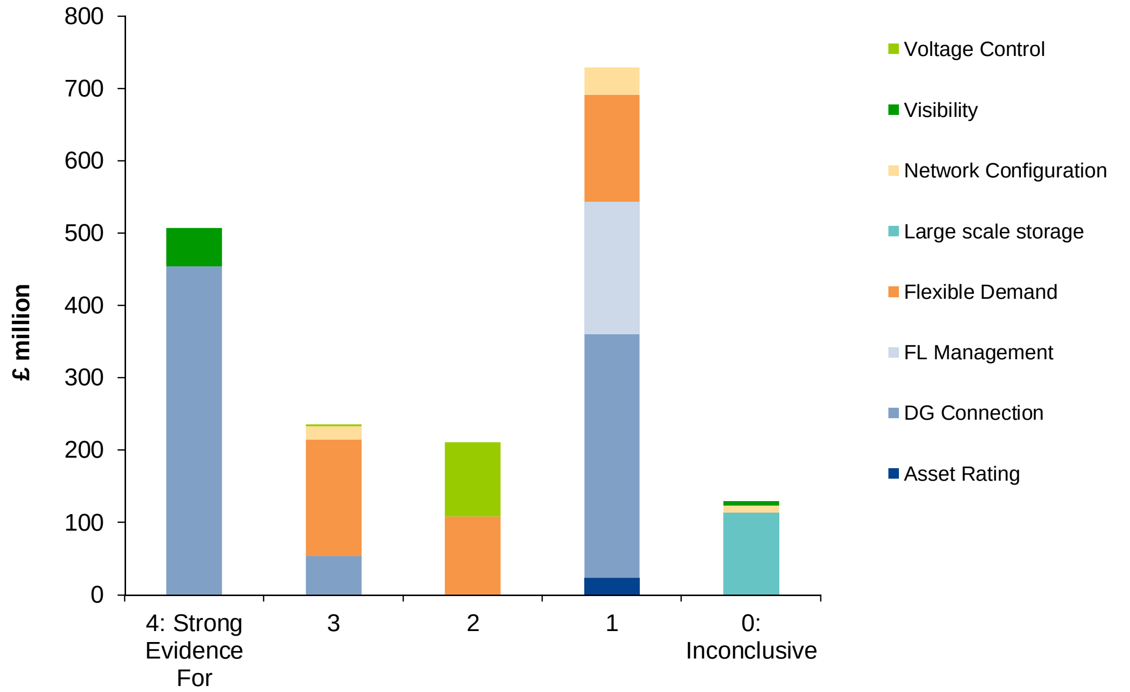
This scoring focuses on the likelihood of the 'individual innovations' being tested (through the LCNF projects), being transferred into BAU. It does not consider the likelihood of the whole LCNF project being transferred to BAU. Our analysis is presented in Figure 29 and characterises each project on the basis of the 'primary innovation' (rather than assess each innovation individually). We have then assessed whether we believe it is likely that the project will transfer to BAU – based on the primary innovation. Using this approach, we looked at all of the projects where a DNO has assigned benefits. From our review, none of the projects with assigned benefits have been assessed as having a BAU ranking below zero – according to the scoring scale shown in Table 17[56].

56 Based on the definitions set out in Figure 7 of the University of Strathclyde Report[16].

Figure 29 shows that in the large majority of cases there was (at least) some evidence or indication that the innovation in question would transfer to BAU. In many cases it is considered that there is strong evidence for this. In no cases did we find evidence or other indication suggesting that innovations with assigned benefits *would not* transfer to BAU. (i.e. our review did not yield any negative score outcomes). Figure 29 presents the full range of scoring outcomes from 'strong evidence for' (Score 4) to 'inconclusive' (Score 0).

The analysis in the academic report shows that a significant proportion of the estimated benefits are associated with projects that have a high probability of moving into BAU. The connection of DG and managing demand on the system are both prominent in terms of the level of estimated benefits and the probability of the innovation being rolled out into BAU. This assessment reflects the current market situation and as a result it should be updated over time as changes to regulation; policy and the physical characteristics of the networks, will potentially impact on the ability of a particular innovation to transfer into BAU.

Figure 29 – Innovation into BAU



Nb. Visibility includes projects which assess innovative solutions to network monitoring
Source: GB DNOs and Pöyry / Ricardo analysis

5.4.2 *Who benefits from the innovation*

A core part of this evaluation is to understand who will receive the benefit from the LCNF innovation projects. Primarily we are interested in estimating how much of the project benefits will accrue directly to the DNO. Understanding the scale of the estimated benefits to the DNO will help to determine the arrangements for future innovation funding mechanisms.

Calculating *how* benefits will flow, *when* they might emerge and to *whom* they will accrue, on an individual project basis, is not straightforward. Part of the complexity arises from the fact that some projects are likely to benefit multiple parties. As a result, in this assessment, we have focussed on identifying who will be the *primary beneficiary* based on the type of innovation associated with the project. This categorisation is shown in Table 18. There are a number of benefits exogenous to the DNO – such as those delivered by the connection of DG, while there are other benefits that can lead to a direct cost saving for the DNO – such as improvements in network configuration, which can help avoid the need for costly augmentation or can improve the effectiveness and efficiency of network operations.

For simplicity we have categorised the benefits in terms of the primary beneficiary – either ‘DNO’ or ‘Other Market Participants’. Ultimately we would expect that these benefits would accrue to end consumers either directly through reduced Distribution Use of System (DUoS) charges[57] (in their final bill) or indirectly through a reduction in the level of CO2 emissions being produced.

Table 18 – Primary beneficiary of the innovation project

Innovation categories	Primary beneficiary (DNO or Other)
Voltage control	DNO
Visibility	DNO
Network configuration	DNO
Large-scale storage	Other Market Participants
Flexible demand	DNO
Fault-level management	DNO
DG connection	Other Market Participants
Asset rating	DNO

The results of this assessment are presented in Figure 30. This chart presents the estimated split of benefits between ‘DNOs’ and ‘Other Market Participants’ alongside the probability of the innovation being adopted into BAU. This probability assessment draws on the analysis presented in a recent academic report on the outcomes of LCNF projects[16].

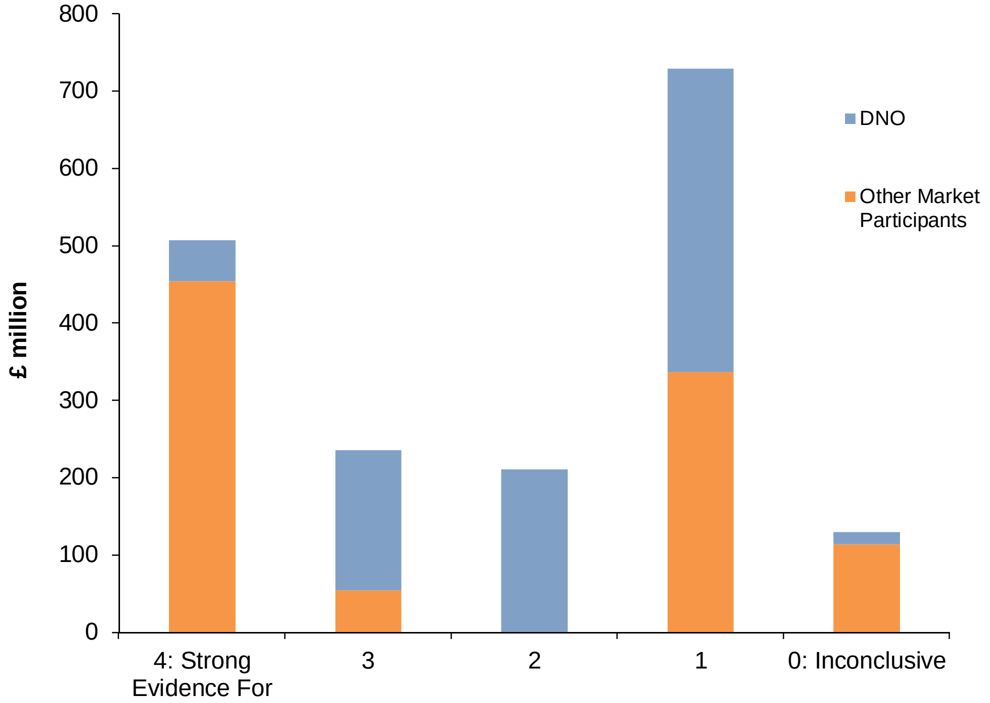
The results show that approximately 55% (approximately £960 million[58]) of the estimated benefits will accrue outside of the DNOs. In addition, for those projects which are the most likely to be incorporated into BAU (e.g. probability categories 4 and 3) the per cent of benefits accruing outside the DNO is approximately 70%. This reaffirms our assessment

57 The RIIO-ED1 framework aims to incentivise innovation to deliver improvements in defined outputs and provides for a sharing of any out-performance benefits between customers (though a future reduction in charges) and the DNO (through revenue adjustments). The sharing ratio is based on the quality of the DNO Business Plan submissions.

58 The equivalent figures for the upper range of estimated benefits are approximately 40% and £980 million.

earlier (see Section 5.4) in which we stated that many of the immediate challenges faced by the DNOs are associated with delivering benefits outside of the DNO businesses. While in the longer-term, the estimated benefits from the LCNF projects are expected to accrue directly to the DNO.

Figure 30 – Beneficiary of the innovation projects



Source: GB DNOs and Pöyry Management Consulting / Ricardo AEA analysis

5.5 Generation connections

Figure 29 shows that facilitating the connection of low carbon generation to DNO networks has been an important feature over the duration of the LCNF. The extent to which this DG would have materialised in the absence of the LCNF is an important question in the context of evaluation of the LCNF. As we set out in Section 2.5.4, while many of the DG connections have benefitted from the innovative solutions identified in the LCNF projects, it is highly likely that there would have been significant pressure placed on the DNOs to enable DG to connect. It is our view, that this pressure to connect would have come from both the generators themselves – who are seeking routes to market – and through the Government as part of their wider aims to increase electricity generation from renewable sources.

This view is reflected by the DNOs who believe that many DG connections would have been made using 'direct inter-trip' arrangements for individual generator units.

In an attempt to quantify this assumption we also sought information from the DNOs on the actual level of MW connected to the (EHV and HV[59]) networks. We requested that the DNOs provide information on the amount (MW capacity) of low carbon generation

59 HV includes 6.6kV, 11kV networks; EHV includes 33kV, 66kV and 132kV (where applicable).

connected to their network over the LCNF period – together with a view on what would have been connected anyway (i.e. in the absence of LCNF support).

The result of this assessment is provided in Table 19.

Table 19 – Generation connected to DNO networks over the LCNF period[60]

	Capacity of DG connections facilitated by LCNF learning	Total DG capacity connected
DG connected to the EHV and HV networks	~700 MW	~17,000 MW

The DNOs estimate that approximately 17GW of total DG capacity was connected to the EHV and HV networks during the LCNF period. Of this approximately 4% (700MW) was a direct result of the LCNF projects[61].

We believe these results support the view that whilst the LCNF project learnings led directly to the connection of *some* new DG capacity, a large proportion of DG is highly likely to have connected anyway and in the absence of LCNF. And in many cases the benefits associated with these DG connections fall outside of the DNO business. This is consistent with our approach to the counterfactual set out in Section 2.5.4.

5.6 Carbon benefits

In this section we present a summary of the estimated *carbon* benefits of the LCNF projects based on our assessment – as outlined in Section 5.2.

There is significant uncertainty in estimating carbon savings. The LCNF projects do not reduce emissions directly, instead they provide innovative solutions to facilitate changes in behaviour or allow the connection of low carbon technology. As a result the actual level of carbon savings will be dependent on a range of factors – many of which are outside the direct control of the DNOs (e.g. types of generation connections, Government policy, customer behaviour, deployment date etc.).

A further uncertainty regarding the potential benefits of carbon is the value which the market places on carbon. Government publishes a set of carbon values to be used in policy appraisal and evaluation[62], however it is uncertain whether in the longer term the actual price of carbon will match these projections. DECC is estimating a 1,232% increase in the carbon price between 2016 (£5.89/tCO2) and 2030 (£78.45/tCO2) in its central scenario – this is clearly a significant change.

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60 Based on submission from 5 DNOs.

61 We recognise that a significant amount of DG may have been connected in the period as an *indirect* result of LCNF project learnings. This information has not been available to us and so this has not been formally determined or reported as part of this evaluation.

62 DECC's latest short-term traded carbon values for use in policy appraisal and modelling were updated in 2015 accounting for the latest market data and revised assumptions that included the EU-wide 2030 energy efficiency, renewables and GHG targets.

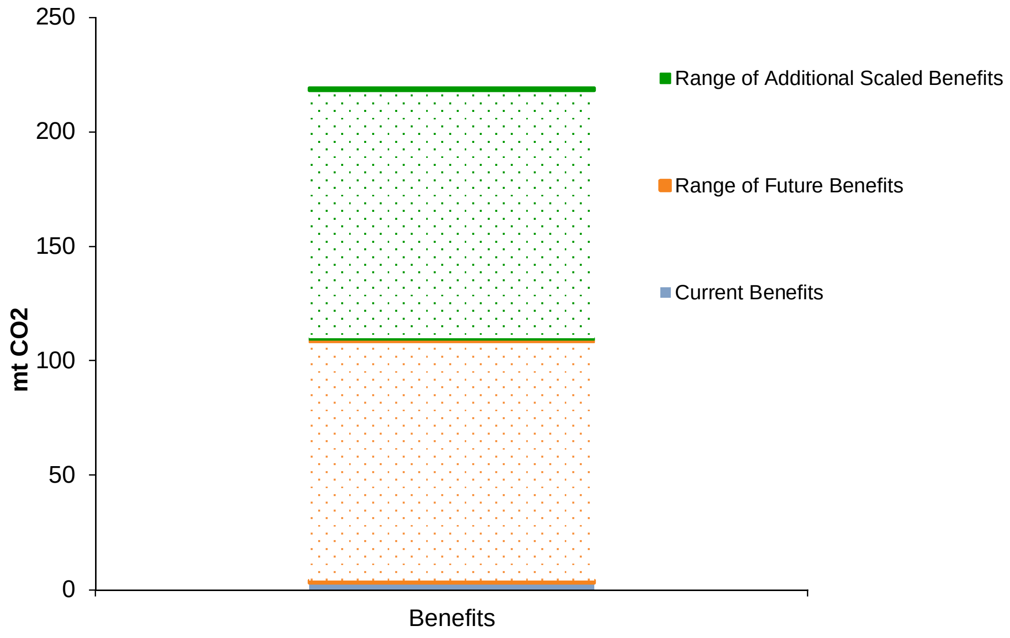
Finally, the referendum decision for the UK to leave the European Union (EU) has also added significant uncertainty into the European carbon market. Any future decision by the UK to leave the EU ETS is likely to lead to an impact on the current and future carbon price.

5.6.1 Overall carbon benefit in mtCO2

Figure 31 presents *current* and *future* benefits associated with carbon savings. The orange shaded area on the chart represents the estimated savings assuming the LCNF projects are only taken forward into BAU on their own network. The green shaded area represents the additional estimated LCNF project benefits when scaled to GB level (using the same methodology as in Section 5.3.3).

The current benefit is approximately 3mtCO2; these are the benefits to 31st March 2016. Future benefits are estimated to range from approximately 107mtCO2 to 215mt CO2[63].

Figure 31 – Carbon benefits in mtCO2



Source: GB DNOs and Pöyry / Ricardo analysis

5.6.2 Overall carbon benefit in £/mtCO2

In Figure 32 we present the estimated benefits above assuming a carbon price of £5.91/tCO2[64].

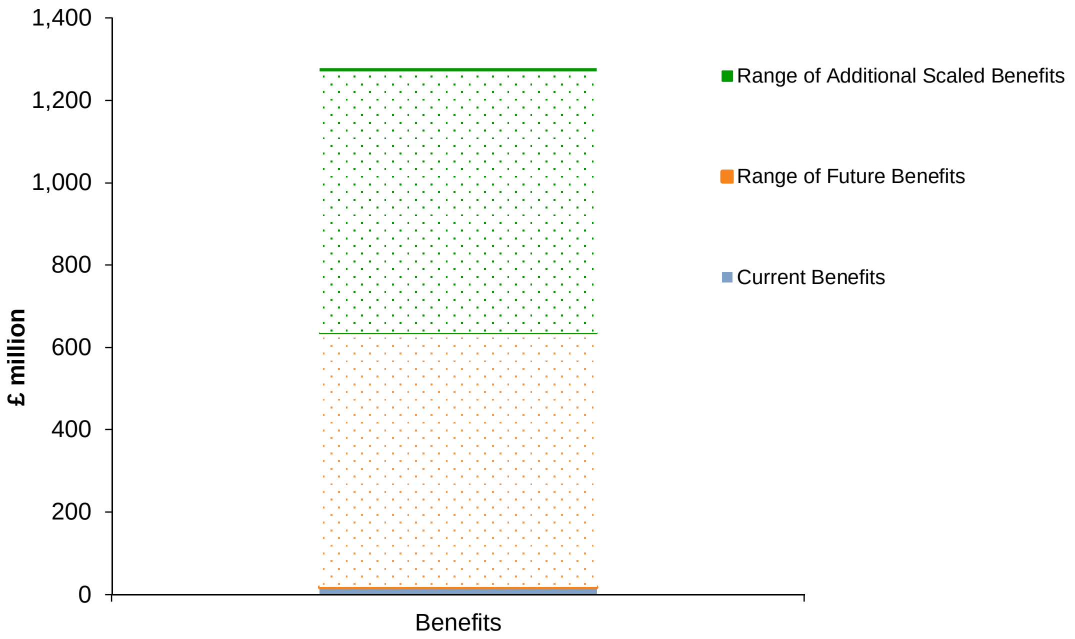
63 As a guide to the magnitude of these estimated savings, the **total** carbon dioxide emissions from energy supply were provisionally estimated to be 136mt CO2 in 2015: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/511684/20160331_2015_Provisional_Emissions_Statistics.pdf

64 https://www.gov.uk/government/publications/updated-short-term-traded-carbon-values-used-for-uk-policy-appraisal-2015

Due to the uncertainty associated with the year in which the carbon benefits are likely to materialise, we have been unable to calculate the financial carbon benefits based on a carbon price for the year in which they would accrue. Instead we base our calculation on the 2016 policy appraisal price. Therefore the benefit presented in Figure 32 is based on a somewhat conservative estimate of carbon price as it would be reasonable to expect the price of carbon to increase in the future.

Figure 32 shows that the current benefits are approximately £16 million (these are the benefits to 31st March 2016). The estimated benefits where the LCNF projects are only taken forward into BAU on the DNOs own network are between £16m and £600m; and finally the scaled benefits are estimated to range from approximately £600m to £1.2bn.

Figure 32 – Estimated carbon benefits in £/mtCO2



Source: GB DNOs and Pöyry / Ricardo analysis

5.7 Summary

Our estimate of the quantitative benefits shows there is potential for large-scale financial and carbon benefits as a result of the LCNF. From the results of this assessment the estimated benefits will exceed the costs associated with the scheme[65]. Although it is acknowledged that a large proportion of the total estimated net benefit is associated with future benefits, which have a high degree of uncertainty.

There are many reasons for this uncertainty. For example the quantitative project benefits rely on our current expectation of the future challenges becoming reality; however this may change as a result of new disruptive technologies that make some of the LCNF projects solutions redundant. Alternatively, it is also possible that the projected

65 For example, the innovative solutions to promote the connection of distributed generation and ability to manage demand are, in our view, highly likely to be transferred into BAU during RIIO-ED1 and deliver the associated benefits.

quantitative benefits of the project trials do not outturn as expected when they are rolled out to the actual network. Finally there is also uncertainty regarding the estimates submitted by the DNO, and while we have attempted to address this through clarification, discussions with the DNOs – and through our own experience and expertise – it is clear uncertainty still exists.

And so it is important that the quantitative benefits are viewed with this uncertainty in mind and are not considered projections. The estimated quantitative benefits should be considered in the wider context of the LCNF and alongside the qualitative benefits outlined in Section 4.

It is our view that reducing the uncertainty surrounding these quantitative benefits should be a key priority of future governance arrangements. Ofgem may wish to review the reporting requirements associated with any future innovation funding. For example, there may be benefit to be gained from an increased level of detail and frequency required for reporting on future innovation projects. One option might be to require more detailed regulatory reporting (e.g. Ofgem may wish to implement an approach similar to the RIGs[66]). There may be complexities with this approach; for instance where non-DNO licensed companies are leading the projects.

Additionally there may be benefits to be gained from more specific reporting after the project ends on the progress to adoption into BAU. For example companies could continue to report the progress of the 'innovation' on an annual basis. This could help to identify when the innovative solution is expected to be installed on the network which should provide more certainty on when the benefits should start to accrue.

66 The regulatory instructions and guidance (RIGs) are the main way we get information from the electricity distribution network operators.

6. REVIEW OF OTHER INNOVATION INCENTIVES – UK AND INTERNATIONAL

A review of innovation incentives, in both UK and internationally, has been included in this evaluation to understand the UK funding opportunities for innovation in the electricity sector and also to seek learning from international innovation mechanisms.

6.1 LCNF and Innovation in GB

There are a number of innovation and research funds and grants in the UK and a selection of some of the most relevant current examples are discussed in the following paragraphs. Funds and grants typically focus on different Technology Readiness Levels (TRL).[67]

6.1.1 Innovation in the UK

The Engineering and Physical Sciences Research Council (EPSRC) is the main UK government agency for funding research and training in engineering and the physical sciences. It invests more than £800m a year in a broad range of subjects, from mathematics to materials science, and from information technology to structural engineering. EPSRC typically looks to fund TRL 1 to 3 research in the identified themes. This funding is aimed at universities and students.

The DECC's[9] Energy Entrepreneurs fund is a competitive funding scheme to support the development and demonstration of state of the art technologies, products and processes in the areas of energy efficiency, power generation and heat and electricity storage. The scheme will only fund innovations between TRL 6 and 8. A number of screening projects are undertaken on each area to enable the projects with the most apparent potential to be selected for further development. The projects are monitored and can be easily halted if required.

In 2013 Innovate UK, EPSRC and DECC set up the Energy Catalyst to encourage innovation to address the energy 'trilemma' of reducing emissions, improving security of supply and reducing cost. In 2016 the Department for International Development (DFID) joined as a co-funding partner. The Energy Catalyst does not fully fund the projects, and there are restrictions on what percentage of the project will be funded for different sizes of companies and research organisations.

The fourth round of competition for innovative projects is being run during 2016. The awards are open to businesses, universities and research organisations and can be associated with technical feasibility, technology development and pre-commercial technology validation. The technologies supported by the Energy Catalyst are designed to address all three aspects of the energy 'trilemma'. The overall budget for the fourth round competition is up to £19 million with some restrictions around the DIFD contribution (developing countries – transforming energy access) and Innovate UK contribution (timescales).

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67 Technology Readiness Levels (TRL) are a method of estimating technology maturity. The levels are typically defined as in the Horizon 2020 programme: http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

Through the 'Innovate UK Energy Game Changer', Innovate UK is investing up to £1.5m in technical feasibility studies to encourage new entrants into the energy sector in order to help stimulate the adoption of disruptive technologies. In Spring 2016 businesses and research organisations applied for funding in three areas associated with inspection, data and energy engagement. The projects had to be led by Small and Medium sized Enterprises (SMEs) whose core business is outside the energy sector. Again the funding does not fully fund the projects, with the proportion of funding depending on the type of project and size of company.

The Energy Systems Catapult is a leading technology and innovation centre set up to help the UK navigate the transformation of the whole energy system and capture the new commercial opportunities created (covering electricity, heat and combustible gases). In addition to funding received from Innovate UK, direct contracts with UK business form a significant part of the overall funding for the Catapults. The Energy Technologies Institute (ETI) Smart Systems and Heat (SSH) Programme was the Catapult's first major project. The SSH programme will develop a suite of software models and heating technologies that will enable the design of location-specific energy systems and improved heating efficiency in buildings. On completion of this programme (end of 2017) the Catapult will seek to undertake a large-scale demonstration of the designs and technologies developed under the programme. SSH will therefore be bringing the TRL from 4 to around 6.

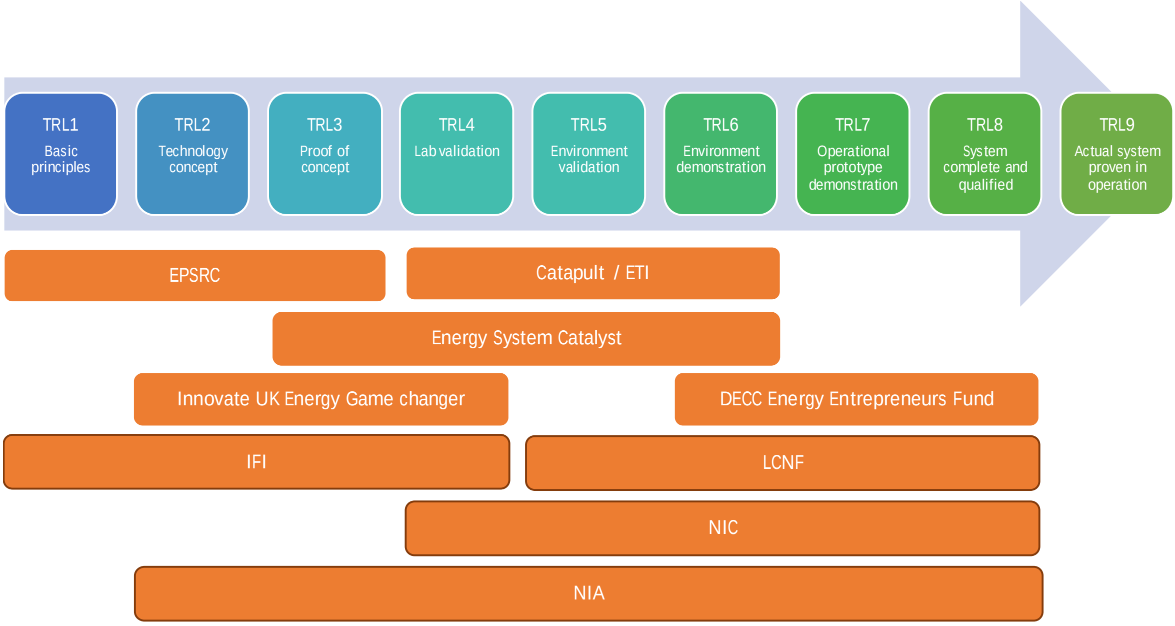
Prior to the introduction of LCNF the DNOs were allowed to spend up to 0.5% of their revenue annually using the IFI. The IFI was intended for technical innovation projects delivering value (e.g. financial, quality of supply, environmental, safety) to customers.

The LCNF has not funded projects at TRL 4 and below. These projects were considered research and development (R&D), which would often have been eligible for funding under the IFI. IFI was replaced in April 2013 with the Network Innovation Allowance (NIA) for operators of the gas and electricity transmission networks and gas distribution networks. The focus of innovation under the NIA has expanded to incorporate commercial, technical and operational research and development projects to complement the previous IFI focus on asset management. The NIA provides limited funding to network licensees to fund smaller innovation projects directly related to the licensee's network (that have the potential to deliver financial benefits to the licensee and its customers) and/or fund the preparation of submissions to the Network Innovation Competition (NIC – which replaces LCNF).

6.1.2 Where does LCNF fit?

The LCNF is specifically targeted at projects that a DNO would not perform in its normal course of business. A first tier LCNF project was required to have a TRL of between 5 and 8. Figure 33 shows how LNCF relates to other innovation funding mechanisms in GB.

Figure 33 – Innovation funding mechanisms and TRL levels



The focus of LCNF on the higher TRL levels (5 and up) may have some implications for projects. For example, the usual focus of university research is at the lower TRL levels, which means that there may be challenges for them to contribute as project partners at higher TRL levels. There are benefits to having universities involved in innovation projects, as their interaction with DNOs and projects can stimulate new research questions, which in turn could lead to future projects at lower TRL levels.

While there may be a possibility for LCNF/NIC to provide some levels of funding for lower TRL projects, it should be noted that other sources of funding, such as the NIA and research councils, fund projects at the lower TRL levels, so support is available.

While many projects focus on technical and engineering aspects, in the transition to a low carbon economy it will also be important for innovation projects to consider other components, such as social elements. There is also currently little funding for whole energy system trials (i.e. those involving the whole electricity value chain and cross-sector trials inclusive of electricity, heat and gas), with the Energy Systems Catapult being the only funding for whole energy systems. The NIC requires two separate bids to be submitted if the project is to consider both gas and electricity and to date there have been no application of this type. There may be scope for future funding to be simplified to include such types of projects.

Overall, it is important that there is coordination and awareness across funding programmes, to ensure that there is no duplication of effort. Well-coordinated information could help DNOs select the most appropriate funding mechanism for specific projects and ensure that innovation is achieved at all levels and across all aspects required to drive a low carbon economy.

6.2 Innovation in Europe

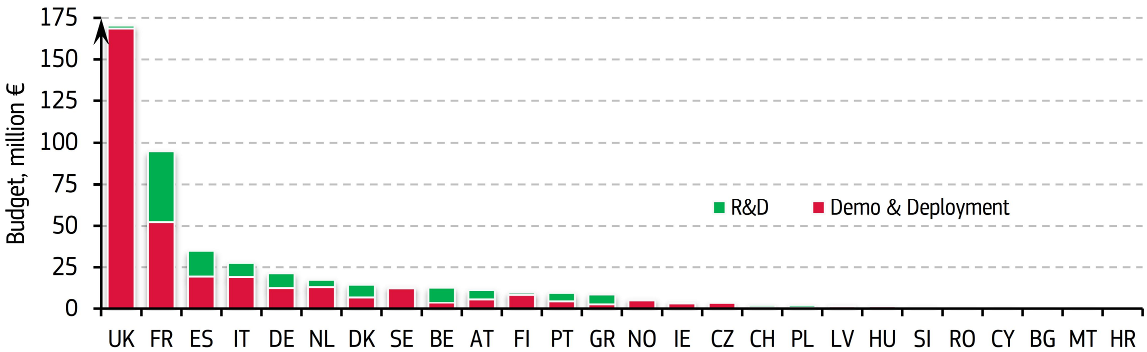
The following section considers how GB fits within European in respect of budgets and the Horizon 2020 funding mechanism which has superseded FP7[68], but this has had little impact on the GB DNOs.

6.2.1 Overview

The following section uses results from a report published in 2014 by the European Commission's Joint Research Centre (JRC)[69].

The JRC's 2013-14 Smart Grid database contains details of 459 smart grid R&D and Demo & Deployment projects from all 28 European Union countries. The database includes projects from 2002 to 2014, but most projects date from 2009 onwards. The total budget for the 459 smart grid projects in JRC's database is €3.15bn. The breakdown by country and by R&D versus demonstration and deployment for 2013 and 2014 (the most recent data) is shown in Figure 34 and budget (per capita) for smart grid projects for all years to 2014 is shown in Figure 35.

Figure 34 – Smart Grid budget by member state, 2013 & 2014 only

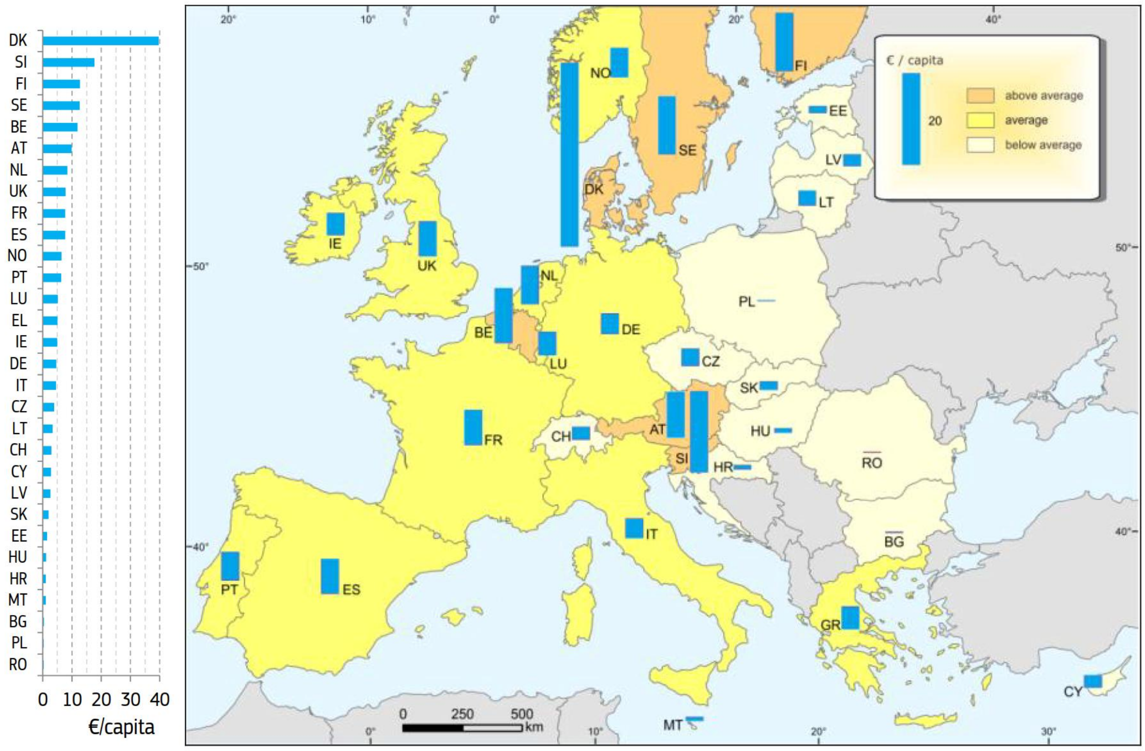


Source: Smart Grid project Outlook 2014, Joint Research Council, European Commission

68 European Commission, Research and Innovation, 7th Framework Programme for Research and Technological Development

69 JRC: Smart Grid Outlook 2014: http://ses.jrc.ec.europa.eu/sites/ses.jrc.ec.europa.eu/files/u24/2014/report/ld-na-26609-en-n_smart_grid_projects_outlook_2014_-_online.pdf

Figure 35 – Budget for smart grid projects across Europe per capita, to 2014



Source: Smart Grid project Outlook 2014, Joint Research Council, European Commission

While the UK total budget ranks first, it ranks 8th of the 28 member states in terms of investment in Smart Grid projects per capita. Denmark is the leader on the per capita metric, with almost €40 per capita, compared to the UK with under €10 per capita.

Table 20 provides a brief comparative overview of the approach to innovation investment in France (second highest overall budget) and Denmark (highest budget per capita) and gives a high-level commentary on comparison to the UK approach.

Table 20 – Comparison of approaches

Main approach	Details	Partnerships	Comparison to UK
France: ADEME (the French environment & energy management agency)			
Smart grid demonstration projects are underway in the framework of the Investments for the Future program. Smart Grid is one of the strategic industrial priority of the "New industrial France" initiative.	ADEME uses dedicated innovation finance schemes to facilitate the sharing of risk and gains, in two forms: 1. Support in the form of state aid, available via calls for expressions of interest published on ADEME's website. Support may comprise: ▪ Repayable advances (loans with a government incentive in the project's success). ▪ Subsidies (only available to SMEs and research bodies). 2. Equity investment as a 'prudent investor': ▪ SMEs in the venture capital or growth capital phase: Eco-Technology Fund overseen by Bpifrance Investissement. Amounts of between €1 million and €10 million. ▪ High-risk industrial projects by mid-size and large companies: ADEME invests directly in project companies. Investment may potentially exceed €10 million.	Projects funded bring together TSO and DSO, equipment manufacturers, ICT companies, local authorities, research bodies, universities and final consumers.	Equity investments in projects under the Investments for the Future program are similar to funding under LCNF. Funding is also available via loans and subsidies, which is different to that provided by LCNF.

Denmark: Energinet.dk and the Danish Energy Association

Following on from recommendations on establishing a Smart Grid in Denmark, the Danish Energy Association and Energinet.dk have produced a road map for the roll-out of the Smart Grid. Some demonstration projects also carried out.	The roadmap focuses on the role of grid companies and provides recommendations for them in developing a Smart Grid. Denmark's demonstration activities include Energinet.dk's cell controller pilot project[70], the EV integration project EDISON[71] and the EU-financed EcoGrid[72].	The Cell Controller Pilot Project was conducted as an international cooperation between Energinet.dk, Syd Energi Net A/S, Spirae Inc. (USA), Energynautics GmbH (Germany) Siemens A/S (Denmark), 47 Wind-turbine owners and 5 Local CHP plants. Partners in the EDISON project included Danskenergi, Dong Energy, Eurisco, IBM, Óstkraft and Siemens.	Denmark has carried out a large amount of strategic work on Smart Grids – developing 35 recommendations on implementation of a Smart Grid in Denmark (2010) and then producing a roadmap for grid companies (2013), which contains actions on a timeline to 2019. There is a clear focus on moving to 100% green power that helps focus their smart grid strategy. In comparison, the UK does not have an overarching strategy. Funding for the various large projects appears to be from different sources and does not appear to be through a mechanism such as LCNF.

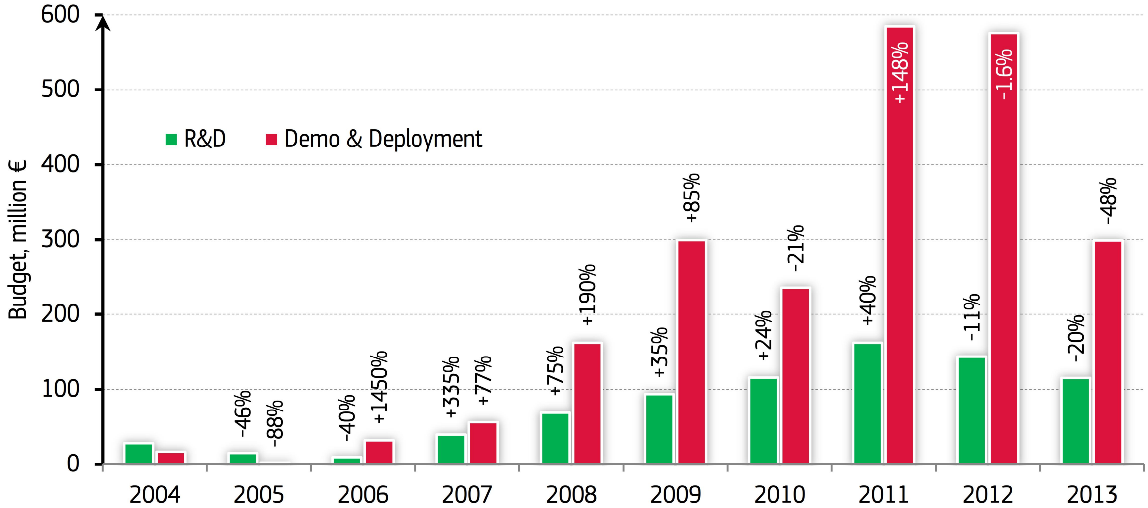
The scope of EU Smart Grid projects has shown a transition from R&D projects in the initial years with greater budget and project numbers on demonstration and deployment from 2008 onwards, see Figure 36.

70 http://energinet.dk/EN/FORSKNING/Energinet-dks-forskning-og-udvikling/Celleprojektet-intelligent-mobilisering-af-distribueret-elproduktion/Sider/Celleprojektet-fremtidens-intelligente-elsystem.aspx

71 http://www.edison-net.dk/Dissemination/Reports/Report_024.aspxt

72 http://www.eu-ecogrid.net/

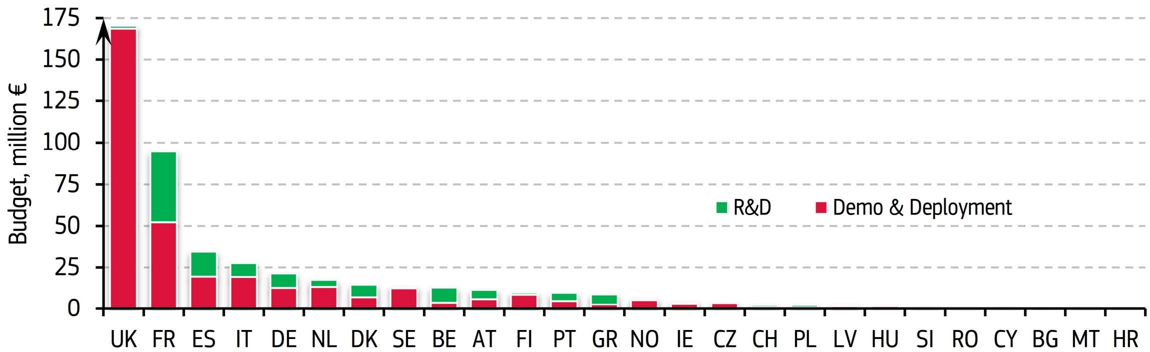
Figure 36 – Budget split for EU Smart Grid projects



Source: Smart Grid project Outlook 2014, Joint Research Council, European Commission

As LCNF projects commenced in 2011, with significant activity from 2012 onwards, Figure 37 shows budget in 2013 and 2014, when significant numbers of LCNF and FP7 projects were underway. This chart shows that the UK led the funding in these years, with France in second place, but significantly lower. In addition, the UK budget is dominated by the demonstration and deployment activities – reflecting the focus required for LCNF activities.

Figure 37 – Smart Grid budget by member state, 2013 + 2014



Source: Smart Grid project Outlook 2014, Joint Research Council, European Commission

6.2.2 Horizon 2020

Horizon 2020 is the largest innovation fund in Europe, with nearly €80bn of funding available over 7 years (2014 to 2020). Horizon 2020 replaced FP7[73] which was the EU's Research and Innovation funding programme that ran from 2007 to 2013. One DNO commented that GB DNOs involvement in Horizon 2020 or its predecessor FP7 has been limited due to the requirement to form international supply chains and collaborations that increase the cost of participation but reduce the UK learning.

73 Ex-Post-Evaluation of the 7th EU Framework Programme (2007-2013), November 2015

An ex-post evaluation of FP7 was carried out in late 2015. This evaluation concluded that FP7 has:

- increased competitiveness of Europe's industry and had a positive impact on growth and jobs (estimated GDP increase of €20 billion per year over the next 25 years, creating over 130,000 research jobs per year and 160,000 additional jobs);
- strengthened scientific excellence;
- achieved greater scale and complexity of projects than otherwise possible. This is because many of the projects funded were of a scale and complexity that meant they needed to achieve critical mass and could only have been carried out at the EU level;
- increased investment; and
- created durable cross-border, cross-sectoral, inter-disciplinary networks.

The evaluation of the programme also identified some elements of the programme which could have functioned better. This included some components that are thought to have hindered its efficiency. While there was collaboration in the programme it was concluded that there was scope for greater synergies.

Recommendations from the ex-post evaluation of FP7, which were to inform Horizon 2020 but are also relevant to other innovation programmes, are as follows:

- it should be ensured that the focus is on critical challenges and opportunities in the global context;
- research and innovation instruments and agendas in Europe should be aligned;
- the key components of the Framework Programmes should be integrated more effectively to avoid fragmentation and the emergence of 'silos' that can undermine efficiency and coherence;
- science should be brought closer to the citizens through engagement of the general public; and
- strategic programme monitoring and evaluation should be established.

An example of an FP7 project is the DISCERN project, where the aim was to learn how to enhance the electricity network by using distributed intelligence.

The LCNF has also been set up so that it provides tangible value to customers, which is an aspect that does not appear as obviously in other international mechanisms, and as the projects have in many cases involved stakeholders LCNF projects have made inroads into one of the FP7 post evaluation findings of engaging with the general public.

Other relevant observations from the FP7 post evaluation findings are to integrate and align research and development which the LCNF did, to some extent, by having the competition for Tier 2 projects, which often followed on from Tier 1 investigative projects. However overall programme monitoring to ensure the learning in each technology area is readily available, together with an industry agreed strategic direction for next steps, and has not occurred.

6.2.3 LCNF and Horizon 2020

Both LCNF and Horizon 2020 have similar objectives in terms of stimulating innovation. However, as LCNF/NIC is more GB network and market-focused and due to the specific energy landscape in the UK (as an island location) having specific and separate UK funding for network innovation is important. In fact, the Horizon 2020 requirements on partnering and international collaboration may act as a barrier to use of this scheme for funding innovation in UK distribution networks (due to the UK being an island nation).

There are currently few linkages between the two programmes. This does raise the risk for duplication of effort. We consider that linkages and engagement between the two programmes could be improved, although the benefits of such linkages should first be considered. This could be achieved through improving links between DNOs and Innovate UK or by encouraging presentation of relevant Horizon 2020 projects at the LCNI conference.

6.3 Innovation in specific European countries

The following section provides a brief outline of innovation incentives that have been implemented in other jurisdictions.

6.3.1 France

In 2009, the French government launched the Investments for the Future programme, which is intended to support projects fostering innovation and the creation of non-relocatable jobs in sectors with strong potential for the French economy. 'Smart electricity grids' is one of the four key areas under this programme. Over 20 demonstration projects in smart grids have been funded under this scheme[74]. Overall, France is one of the leading countries in Europe (along with the UK) in terms of investment in smart grids.

6.3.2 Denmark

Denmark has a goal of achieving 100% of power from green sources by 2035 and aims to be fossil fuel free by 2050. The Danish energy system is therefore well-suited as a platform for development of future smart grid technologies. Denmark has practical experience in grid challenges that need to be solved, as well as expertise in energy storage technologies. A number of demonstration projects have been carried out in country including Energinet.dk's cell project, the EV integration project EDISON and the EU-financed EcoGrid.

6.3.3 Germany

DSOs can apply for the cost recognition of R&D projects. The National Regulatory Authority is allowed to approve revenue adjustments for projects that are considered to be innovative. Funding is available for 50% of the project with the DSO providing the remaining 50%.

6.3.4 Ireland

The Smart Grid Innovation Hub (SGIH) in Ireland, established in 2012, is an advocacy network for both the Republic of Ireland and Northern Ireland, whose aim is to promote the development of innovative Smart Grid ideas and facilitate the delivery of a secure, affordable and sustainable energy infrastructure. It is a collaborative initiative between

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74 Source:http://www.cleanenergyministerial.org/Portals/2/pdfs/GSCN_ADEME_Smart%20Grids.pdf

EirGrid, SONI[75] and the National Digital Research Centre (NDRC). It provides access to the people, systems and data necessary to test ideas and concepts and enable them to develop from ideas to reality. Support provided by SGIH is tailored for each specific project or company depending on its stage of development and/or specific support requirements.

One of SGIH's projects is the North Atlantic Green Zone (NAGZ) project, which is a cross border project in the north west of Ireland. The project will provide increased capacity, access and reliability of networks for all users and has been recognised by the Global Federation of Competitiveness Councils in the Best Practices in Competitiveness Strategy for Regional Innovation.

6.3.5 Finland

Finland has in place a regulatory model that includes an innovation incentive allowing a proportion of research and development (R&D) costs to be passed through to customers. The network company still has to consider the balance between costs, benefits and risks before initiating a project. This is similar in structure to the LCNF in the GB market.

However, in Finland, the use of replacement costs for investments when determining the remuneration on regulated assets serves as a disincentive to invest in developing technologies where costs are expected to reduce over time.

6.3.6 Italy

Italy introduced a legislative decree from 2011 which introduced an extra-remuneration on the WACC for modernizing distribution networks in a 'smart way', i.e. deploying solutions such as control, regulation and management of load and generating units, including also EV charging systems. Moreover, demonstration projects can receive an extra remuneration on CAPEX.

The extra WACC remuneration of +2% is allowed for 12 years on the part of the regulatory asset base associated with investments needed for the demonstration project (ordinary WACC is 7% pre-tax, which implies that total WACC for smart grid demo projects is 9% for 12 years and then back to 7% for rest of life span of the investment).

6.3.7 Norway

Since 2013, regulation allows for passing through of R&D costs to a certain degree. The projects shall be aimed at contributing to an efficient operation, utilisation or development of the electricity network, recommended by the Research Council or similar institution.

6.3.8 Portugal

There is an incentive of an extra 1.5% remuneration on the asset base of innovative projects. This only applies to small R&D/pilot projects and excludes any mass deployment of innovative technology. Furthermore, it requires extra cost-efficiency that more than offsets the extra remuneration of the asset base.

75 SONI is the electricity system operator for Northern Ireland and has been part of the EirGrid Group since 2009. SONI run a Technology and Infrastructure programme that focuses on developing the existing grid, delivering advanced network solutions, deploying new technologies on the grid and enabling additional HVDC interconnection to Europe.

6.4 Suggestions for GB and European innovation funding

While there are a range of innovation funding mechanisms in GB and Europe, there are still areas that could be improved to further stimulate innovation. Some suggestions, as outlined by respondents to questionnaires, included:

- cross-industry collaboration could be improved, such as between electricity heat and gas, or between energy and transport. Such linkages will help stimulate transition to a low carbon economy;
- projects should be encouraged to not only focus on the technical considerations, but also include institutional, regulatory, investment, political or social dimensions;
- the complexity and time requirement of funding applications can make it a challenge for smaller companies or research groups to get funding, in comparison to large companies that have dedicated teams for these activities. Simplification of some requirements for smaller groups may help stimulate additional innovation; and
- there may be the potential to encourage project participants to have young staff or students working on the projects. This would be an investment for the future and may also help with any resourcing constraints for innovation projects.

6.5 International Innovation Funding

There are a number of additional innovation competitions worldwide. These fall across a number of sectors and are often provided in the form of a prize fund, which is only available once an upfront commitment has to be made. There are also some innovation schemes based in academia. Some examples include:

- the Advanced Research Projects Agency-Energy (ARPA-E; part of the U.S. Department of Energy), which advances high-potential, high-impact energy technologies that are too early for private-sector investment. ARPA-E awardees are unique because they are developing entirely new ways to generate, store, and use energy;
- US Department of Energy National Laboratories. Through initiatives like the Loan Guarantee Program and the Advanced Research Projects Agency - Energy, the Department funds research and the deployment of innovative clean energy technologies. The Department also encourages collaboration and cooperation between industry, academia and government;
- the Electric Power Research Institute is an independent, non-profit US organisation, which conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public;
- the Energy Market Authority (EMA) in Singapore rolls out competitive grant calls to catalyse applied research and development (R&D) of innovative technologies and solutions. This included a Smart Grid Grant Call in 2014; and
- the Fraunhofer Institut is Europe's largest application-oriented research organization. Their research efforts are geared to people's needs: health, security, communication, energy and the environment.

6.6 Summary of international learning

The UK programmes cover the whole range of TRLs from EPSRC funding of academic research through to the high TRL levels where Innovate UK and DECC initiatives fund innovation. In respect of programmes focused on the distribution networks the NIA and NIC fit well into the TRL levels. The recent NIA and NIC fit in a similar space, but have a requirement for at least TRL2 as a starting point and cover transmission and distribution of both gas and electricity. This leaves TRL 1 as a space for the academic determination of basic principles.

There is little detail about specifics of governance arrangements internationally, with a range of funding mechanisms such as a prize fund, a loan programme and a partially funded initiative in a regulatory environment. This review has found some relevant observations from the European funding programmes:

- innovation focus should be on critical challenges and opportunities in the global context;
- ‘Smart-Grid’ innovation and investment represents an opportunity for wider industrial research and development, and collaboration, in France this is recognised through inclusion in the ‘New Industrial France’ initiative;
- an industry agreed strategic direction for next steps should be developed, as seen in Denmark;
- overall programme monitoring would ensure the learning in each technology area is readily available;
- cross industry collaboration could be improved, such as between electricity, heat and gas, or between energy and transport. Such linkages will help stimulate transition to a low carbon economy, given expected changes in the heat and transport sectors;
- projects should be encouraged to not only focus on the technical considerations, but also include institutional, regulatory, investment, political or social dimensions;
- requirements for funding opportunities should be simplified as far as possible to enable small companies and research groups to be involved; and
- encouragement of project participants to have young staff or students working on the projects would be an investment for the future.

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7. CONCLUSIONS AND RECOMMENDATIONS

This section presents the key findings and conclusions associated with our evaluation of the LCNF. This considers performance against the LCNF objectives, integration into business as usual, and whether the LCNF has delivered value-for-money. We also set out our recommendations.

7.1 Conclusions

The LCNF has succeeded in encouraging DNOs to innovate and has served to move the level of innovation within the DNOs from a 'low' base to a 'moderate' level.

Prior to the introduction of the LCNF, the total level of research and development (R&D) expenditure within the DNOs is estimated to be less than £10m per annum and there was concern that the price control mechanism was encouraging companies to seek short-term cost savings to the detriment of innovation research – which often needs a longer-term for pay off. In establishing the LCNF, Ofgem was aware of the challenges regulated businesses face in the area of innovation and aimed to replicate the incentives on unregulated companies to innovate.

Figure 38 illustrates our view on the progression that has occurred in innovation within the DNOs over the LCNF period. This evaluation has established that innovation within the DNOs was considered to be at a 'low' level[76] prior to the introduction of the LCNF, and with no significant change year-on-year in respect of the level of Innovation Funding Incentive (IFI) expenditure.

The requirements on the DNOs to effectively and efficiently deliver its licensed services – whilst maintaining an acceptable financial (and technical) risk profile and in accordance with the price control settlement – sets a challenging environment for innovation to thrive. This is borne out as, despite the IFI and Registered Power Zones (RPZ) incentives for small scale innovation, some respondents to the questionnaire described the pre-LCNF DNO attitude to innovation in a way that supported the definition of 'low' innovation. DNOs were perceived, by some, as having little or no interest in innovation, with comparatively few innovation projects and with no overall programme to examine innovation opportunities.

However, it is also clear from our evaluation that there are barriers that affect the achievable level of successful innovation. Many of these appear to be the result of governance constraints and the fact that, in some cases, the ultimate beneficiary of the innovation falls outside of the DNO business. Many of the innovation schemes have been designed to deliver value-for-money to generation connections by the use of 'smarter' solutions such as Active Network Management (ANM). Other schemes have been designed to deliver value-for-money to demand customers by the use of 'smarter' solutions such as Demand Side Response (DSR). Some respondents to our evaluation questionnaire felt that ANM and DSR would not be possible without the LCNF.

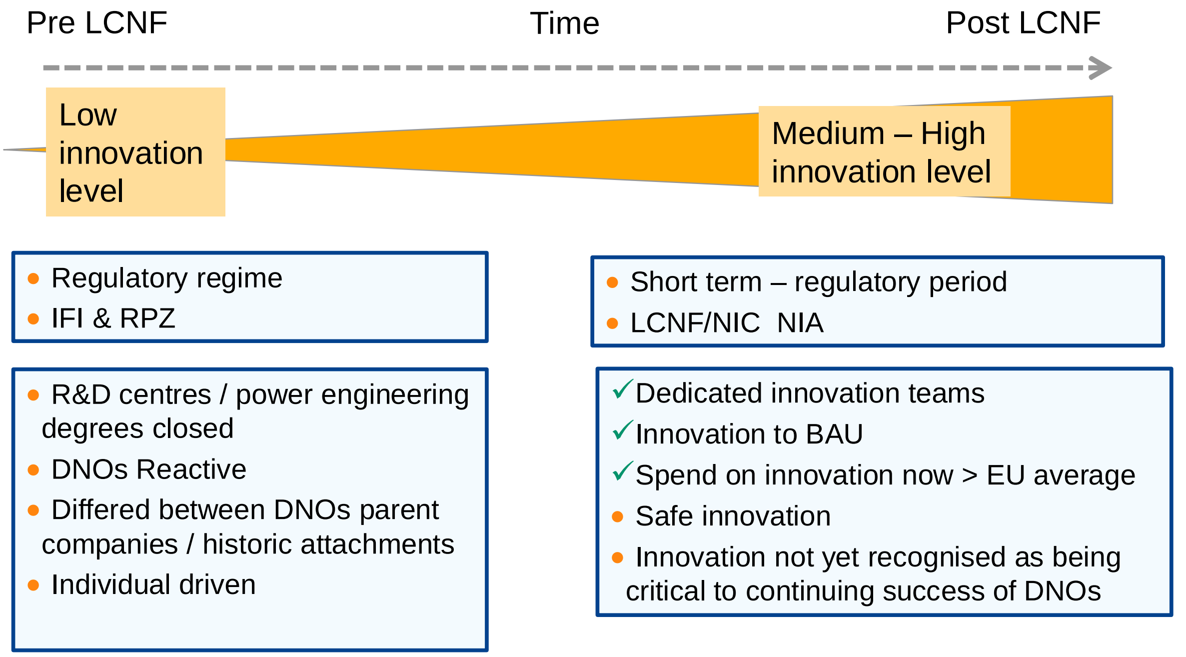
LCNF has enabled innovation projects to be undertaken in a 'safe' environment; with the technologies explored often building on previous knowledge or learning acquired through

76 Refer to Annex F for definitions of innovation levels.

prior LCNF projects. The innovation is managed by comparatively few people and implementation of initiatives into BAU is comparatively slow.

In our view many DNOs do not believe that innovation is *critical* to the continued success of the business and, therefore, DNO innovation is not yet at a level which could be defined as being 'high[77].

Figure 38 – Progression of innovation over LCNF period



LCNF has encouraged DNOs to include innovation as core business, with encouraging sign of transfer to business as usual – but this is still progressing

DNO businesses have evolved since the introduction of the LCNF by expanding their Future Networks Groups, with both the technical, commercial and support staff needed to run innovation projects. There are a variety of models used across the DNOs to integrate the main business functions with the innovation projects but all aim to create awareness of the need to consider the Low Carbon Technology (LCT) take-up in the context of a 'smart' future, as well as to enable the specific innovation projects to enter business as usual (BAU) practice where applicable.

The DNOs all recognise the importance of innovation to help resolve the future challenges associated with LCT. This is reflected in the RIIO Business Plans. Smart grids are also identified as being a key part of the DNO future network development strategies.

The general consensus from questionnaire respondents was that DNOs have either achieved, or are working towards, including innovation as part of their core business –

77 Refer to Annex F for definitions of innovation levels.

although there is still some uncertainty regarding the extent to which the benefits of innovation are fully reflected in DNO Business Plans.

The questionnaire respondents expressed some concerns about whether or not the competitive nature of the LCNF application process hinders true collaboration and sharing and whether the culture of the LCNF is sufficiently accepting of failure and able to assimilate the benefits that accrue from learning about failure.

The innovation initiatives from the projects themselves have been shown to have mixed success in terms of being taken into BAU. There is general agreement across the industry that, in hindsight, the predictions made by DECC[9] in respect of the take up of electric vehicles and heat pumps in the period prior to the LCNF were wrong. However, the expectation is that demand will increase and demand profiles will continue to change over time and that the learning from the projects will be implemented during the RIIO ED2 price control.

Current benefits are estimated to be approximately one third of the total funding.

The evaluation identifies estimated current benefits (i.e. those to 31 March 2016) of £96m – this is equivalent to 35% of the total funding. The majority of these current benefits derive from the connection of increased levels of renewable distributed generation and managing demand on the system.

These current benefits may also support wider Government policy – for example, impacting on policies such as security of supply requirements. In contrast, many of the longer-term solutions are more likely to lead to benefits for the DNOs – for example, by ensuring that DNOs are better prepared for the disruption that the take-up of LCT may have on the networks.

The potential future benefit from the LCNF projects is significant and is estimated to range from 4.5 to 6.5 times the cost of funding the scheme.

The project costs for Tier 1 and Tier 2 projects are approximately £275m. Tier 2 projects account for the majority of this cost at £245m, while the finding of Tier 1 projects is approximately £30m.

Our assessment of the estimated quantitative benefits shows there is significant potential for large-scale financial and carbon benefits with the estimated net benefit of the LCNF – including *current* as well as *future* benefits – ranging from £1.1bn to £1.7bn and carbon savings ranging from 107mtCO2to 215mt CO2[78]. Therefore it is clear that the estimated potential (current plus future) benefits exceed the costs associated with the scheme.

[78] This is equivalent to benefits of approximately £600 million to £1.2 billion at a carbon price of £5.91/tCO2.

Projects which focus on the connection of distributed generation and flexible demand have a high potential value and are the most likely to be readily incorporated into current-day business practice.

The innovation schemes are designed to deliver value for money to generation and demand customers by finding 'smart' solutions such as ANM and DSR.

The benefits of some of the projects fall to connecting customers, or to those providing response services to national markets. However, some LCNF projects have, or will, lead to a reduction in Distribution Use of System (DUoS) charges as a direct result in the opportunity for DNOs to defer network reinforcement through, for example, enhanced voltage control or improved management of fault level.

In general, the benefits associated with the connection of distributed generation and flexible demand projects are significantly greater than those benefits where asset replacement may be deferred. There are also potential benefits to GB as a whole, with respect to the potential for the export of products and learning to other parts of the world experiencing similar challenges.

There is insufficient high-level overview and co-ordination of individual projects to ensure alignment with the overall direction of the industry.

A large number of innovation initiatives have been undertaken across a range of technical and commercial areas under the LCNF, and this can be used to provide some measure of success. However, whilst each DNO has a high-level strategy for innovation within its Business Plans, there does not appear to be any overarching plan to ensure the direction of future innovation funding aligns with, and supports, the overall GB energy strategy. For example, doing this would allow proper consideration of the need for a residential demand side response strategy – taking account of the smart meter roll-out timescales and the early learning from the LCNF projects.

Whilst the quality and methods of dissemination of information for individual Tier 2 projects is high, it has been observed that the Tier 1 projects do not receive such a high priority in this respect. There is a lack of overall programme monitoring to ensure the learning in each technology area is readily available[79].

The LCNF has led, directly, to an unprecedented level of DNO engagement with customers.

Over 100 third parties and stakeholders have been involved with LCNF projects. Generally there was found to be effective collaboration and engagement between the DNOs, third parties undertaking the projects and stakeholders. However it was noted that this was not always the case – with some respondents to our questionnaire suggesting that there is opportunity for improvement to achieve best practice. Some barriers to project partner involvement were identified associated with the reputational and/or

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79 This is similar to the conclusions reached in the EU Research Funding 'Framework Programme 7'post evaluation findings.

financial risk of undertaking innovative projects whilst at the same time demonstrating value-for-money and managing Intellectual Property Rights within the LCNF requirements.

7.2 Recommendations

Ofgem should continue to fund DNO innovation to ensure the culture of innovation continues to develop. Consideration should be given as to how support for DNO innovation can best accommodate the future requirements of the whole energy system

Support for innovation should continue in order to maximise the benefits associated with innovation investment to date and exploit gains from the 'momentum' that has built-up over the LCNF period. This should continue with appropriate supporting incentives until a high level of innovation[80] is reached and the innovation culture is embedded within the DNOs. This will maximise the likelihood that valuable innovation continues and will also provide ongoing opportunity for Ofgem and other key stakeholders to work with DNOs in determining future areas of focus.

The support could be widened to include third parties directly receiving funding – provided the projects draw on DNO experience, encourage DNOs to provide access to networks and ensure the outcomes add value to the DNO businesses. The potential advantages and disadvantages of this approach are summarised in Table 13. Governance arrangements for direct funding of third parties would have to be developed in detail. This would need to consider the contractual and governance arrangements, including potential legislative changes, required to safeguard against, amongst other things, under-performance etc.

As well as consideration of the financial and low carbon benefits, the expected initial beneficiaries of innovation should be clearly identified by each project and quantified at the completion of the project.

The DNOs should be required to jointly develop and publish an 'innovation roadmap'. This should be developed in conjunction with the System Operator, the transmission companies, other parties such as Independent Distribution Network Operators and participants associated with other energy vectors such as gas, heat networks and transport. Research funding bodies such as EPSRC, DBEI, Innovate UK and other relevant industry initiatives should also be included to ensure funded innovation is optimised to deliver maximum benefit for customers.

As well as including the transmission System Operator, onshore and offshore transmission network operators, Independent Distribution Network Operators and, potentially, Competitively Appointed Transmission Owners(CATOs), the *roadmap* should take account of other innovation funding opportunities such as Horizon 2020, the EPSRC, Department of Business, Energy and Industrial Strategy (formerly DECC) 'Entrepreneur Fund' and the Innovate UK Energy Systems Catapult as well as other relevant industry

80 A high level of innovation is fully defined in Appendix F.3 as being a level where innovation is recognised as a vital ingredient of the business whose success is dependent upon it.

initiatives such as the Smart Grid Forum work[81], smart meter roll-out and the Future Power System Architecture project[82].

The DNO Business Plans, including the Innovation Strategy Annex, should be developed in a way that takes account of the *road map*. Learning outcomes from the LCNF projects that do not feed directly into BAU – perhaps because the current energy landscape does not yet require the solution – should be recorded as part of the innovation road map so the options for the future are clear, gaps can be identified and past learning can be maximised as required.

There is an opportunity to also consider international innovation learning and development as well as other energy vectors such as gas, heat networks and transport to assist with the optimisation of the future energy sector.

There should be greater focus on the sharing of project knowledge and learning – particularly across and between the DNOs –in order to maximise the benefits and value of LCNF initiatives and innovation

It may be appropriate for specific DNOs to 'champion' particular initiatives and to take responsibility for the overall direction and coordination of innovation in a subject area at a GB level. This responsibility could change over time, or could be formally rotated. This should include responsibility for collating and disseminating overall learning in high-priority innovation initiative areas – both technological and commercial. This ought not to preclude a DNO from investigating any topics independently, or exploring alternative solutions to the same problem at the same time, rather it would aim to ensure that there is no duplication of learning and that progress is made for the benefit of all.

Unique challenges associated with individual networks should still be able to be addressed where the business case is demonstrable.

Learning outcomes from the LCNF projects that mean further work is necessary to reach a solution or where it is clear the original anticipated benefits are not realistic or attainable should be captured by the appropriate initiative champion and recorded as part of the innovation road map. This will ensure that the potential for value to be extracted in future, as the energy landscape changes, is maximised. Consideration should also be given to the benefits of a peer review of the projects objectively examining the less successful parts of projects for their potential for success in other DNOs or areas.

Reporting requirements associated with any future innovation funding should be reviewed to facilitate the future assessment of quantitative benefits. Ongoing reporting should include project outcomes, learnings and also the progress associated with business as usual implementation of LCNF initiatives.

Reducing the uncertainty surrounding the quantitative benefits should be a key priority of future governance arrangements. Ofgem may wish to review the reporting requirements associated with any future innovation funding. For example, benefits may be gained from there being more certainty on the level of detail and frequency required for reporting of

81 http://uksmartgrid.org/

82 http://www.theiet.org/sectors/energy/resources/fpsa-project.cfm?origin=reportdocs

future innovation projects. One option is to ensure that the reporting is part of a regulatory submission (e.g. Ofgem may wish to implement an approach similar to the RIGs[83]). There are obviously challenges for this approach, especially if non-DNO licensed companies are leading the projects.

There may be additional benefits to be gained from more specific reporting on the move to BAU following the end of the project. For example companies could continue to report the progress of the 'innovation' on an annual basis. This should help to identify when the innovative solution is expected to be installed on the network, which should provide more certainty on when the benefits should start to accrue.

LCNF participants should be encouraged to co-ordinate with relevant Government departments, and other institutions, to explore opportunities to share and exchange project learnings, and experience, with other sectors and with other countries and jurisdictions.

Co-ordination of Government, Ofgem, the DNOs and other relevant stakeholders is encouraged to extract the full value to GB of innovation by ensuring overseas technology transfer, both in respect of opportunities for knowledge and equipment transfer. This would be expected to result in economic benefits to GB plc. Other interested parties would be manufacturers, SMEs, consultants and academics.

7.3 Implementation

It should be noted that the recommendations presented in Section 7.2 are the views of the project team and have not been discussed or agreed with the DNOs or any of the other parties mentioned. Implementation of these recommendations would involve detailed discussion and exchanges between Ofgem, the DNOs and transmission companies. Some of the recommendations also involve other parties with whom we would encourage Ofgem to engage

Specific recommendations for Ofgem to consider with respect to the NIC governance arrangements are provided in the Section 7.3.1. These cover the management of uncertainties associated with scoping, bidding and implementing innovation projects, changes to enable easier submission of cross industry bids and the benefits of providing further guidance about the scheme to better enable project partner engagement and involvement.

7.3.1 Recommendations for modifications to the NIC governance arrangements

Version 2.1, 26 June 2015, of the Electricity Network Innovation Competition Governance Document has been considered against the relevant findings of this evaluation in respect of recommendations for governance modification.

83 The regulatory instructions and guidance (RIGs) are the main way Ofgem get information from the electricity distribution network operators

Table 21 – Recommendations for governance modifications

NIC	Proposed change
Initial Screening Process criteria:	
a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits while having the potential to deliver net financial benefits to existing and/or future network customers	It has been observed that: ▪ specific expertise in respect of an innovative idea may lie with one, or few, companies and hence competition may be difficult to achieve; ▪ the cost of the project is difficult to determine due to the uncertainty around it's innovate nature; and ▪ the uncertain energy landscape can make the creation of a robust business case challenging. More guidance could be given on acceptable assumptions in respect of costs, acceptable mitigations throughout the project and expected financial benefits due to the uncertainty of the future. This could include scenario considerations – upper and lower from National Grid Future Energy Scenarios as appropriate. Also in respect of assumptions for roll out to GB scale.
Evaluation criteria	
5.41. Cross industry projects that wish to apply for funding from more than one competition (i.e. the Electricity NIC and the Gas NIC) must submit bids separately to each competition stating what funding has been requested from which competition. The level of funding requested from each competition should be commensurate with the expected benefits for customers in the relevant sector.	No cross-industry project bids have been submitted which could suggest the requirement for two bids is an over complicated approach. It would be sensible to request one bid within which the benefits to customers in the relevant sector are detailed.

5.44. The Evaluation Criteria that will be taken into account in evaluating NIC Projects are set out below. (e) 5.58 v) Involvement of other Project Partners and External Funding Accessing secure additional funding will be looked on favourably: the higher the proportion of External Funding to requested NIC Funding the better. This may be from other External Funders or from Project Partners who have an interest in the results of the project, or from the Network Licensee contributing more funding than the Network Licensee's Compulsory Contribution. Indeed, where the benefits from the Project lie outside of the Transmission System or of the Distribution System (as identified under criterion (b) above) we would expect collaborators to be involved and to provide funds commensurate with the benefits they could be expected to get from participating in the Project.	This initial statement is biased in respect of the securing of additional funding which, even though qualified in the paragraph, can be seen as a prohibiting factor to innovative SMEs who may not be in a position to offer any form of contribution. Consideration should be given to reviewing this requirement.
Project changes	
8.22 & 8.22 cover the requirement to submit a request to change to Ofgem.	Details of the change-request process would add clarity for project partners. More detail could be given to reflect the uncertain nature of innovation and increased involvement by Ofgem would be welcomed by the DNOs and industry parties in this respect – as well as in acknowledging the need to actively manage risk associated with innovation projects.
Other – Guide for project partners	It was noted that a guide for project partners explaining the fund and revenue stream would be helpful – particularly for SMEs.
Other – Best practice in partner management	It has been observed that there is a range in the level of engagement and practice with respect to partner management by DNOs and within DNOs and there is a need to consider and aspire to consistent best practice in this respect.

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ANNEX A – RESPONSES OF DISTRIBUTION NETWORK OPERATORS

A.1 Benefits of the LCNF Projects

A.1.1 Stakeholder Engagement Mechanisms (Q1.3.1)

Questions:
Please outline the stakeholder engagement mechanisms you have used to develop LCNF projects?

A.1.1.1 Engagement Mechanisms

All of the respondents made the point that their stakeholders were regularly consulted with on issues they care about, and were welcome to propose ideas and approaches.

One of the DNOs informed us of their robust strategy with regards to stakeholder engagement made up of three main aspects; stakeholders generating ideas for projects, stakeholders identifying the business direction and thus prioritising and potentially identifying project partners.

This respondent also has staff members that lead engagement in their local areas with local stakeholders – ensuring the DNO is aligned with the local communities that use their services.

Another DNO believes their collaboration with their stakeholders was essential in allowing them to outline project scopes, engage with project partners, get customer feedback and present their findings to relevant parties.

One of the DNOs states that they have an “open door” for stakeholders, including the supply chain and academics, for the initial assessment of new technologies, practices and commercial arrangements. They have formal engagement sessions with stakeholders, as well as consulting through more informal dialogue.

Another of the DNOs follows internationally recognised best practice in stakeholder engagement – the AA1000 Account Ability Principles Standard (AA1000APS) – the pillars of this standard are inclusivity, materiality and responsiveness. They say that their business plans and innovation strategy are created with consideration for the fundamental aims of their stakeholders – providing a network that is; reliable, affordable, sustainable, and delivered with excellent customer service. This DNO engages with the community, SMEs and larger organisations in order to develop an innovation plan.

Forums were identified as an engagement mechanism by the final DNO – using the Distributed Generation forum and the Transmission User forum to communicate new and existing projects to stakeholders.

A.1.2 Process to Develop LCNF Project Ideas (Q1.3.2)

Questions:
Please outline the processes you have used to develop the LCNF project ideas?

A.1.2.1 Ideas Generation

Stakeholder engagement was mentioned by three DNOs as a part of their idea generation process; to identify opportunities, areas in which to innovate or project ideas.

Another of the respondents generates a "long list" of project concepts – these are either generated internally or from vendors (including a number of SMEs). In 2016 half of the "long list" (12 ideas) consisted of ideas internally generated, and half from other vendors – including 3 from an industry consortia and 1 from a SME.

One of the DNOs listed some of their sources of project ideas – emails sent directly to individuals or to the general innovation email account, calls for ideas via the normal tendering process and ideas that previous collaborators approach with.

Another respondent's approach to the initial idea stage is to generate a list of areas in which they would like to innovate – this comes from stakeholders, bottom-up internal viewpoints and a top-down executive viewpoint. It is ensured ideas are collected from many sources.

A.1.2.2 Selection of Projects

The DNOs mentioned a number of factors that are considered when selecting projects, the main one as mentioned by three respondents was that the projects are aligned with the company's intended direction/business aim's and innovation strategy.

Various other factors were mentioned by one of these respondents:

- learning and outputs from existing project portfolio;
- learning and outputs from projects in other sectors and from other DNOs;
- business needs and gap analysis;
- stakeholder needs and requirements;
- avoidance of duplication with previous projects;
- need for innovation funding and compliance with governance arrangements;
- timeliness of the solution in relation to the challenges the industry and our stakeholders face;
- risk and opportunity assessment;
- replicability and relevance of the solution to other license holders;
- technical readiness;
- value assessment; and
- prospective business case (in the widest sense).

A.1.3 Parties Approaching with Project Ideas (Q1.3.3)

Questions:
Please provide details (to the extent possible) of companies and contacts who may have approached you with ideas for LCNF projects, but with whom you did not work? If possible can you explain why you chose not to go ahead with their ideas?

A.1.3.1 Reasons for Rejection

The main reasons, as provided by more than one respondent, behind network operators declining project ideas were found to be:

- to avoid duplication of similar projects taken on by other DNOs, as said by three respondents;
- the project would not result in enough benefits, to the DNO or their customers, as said by two respondents;
- projects not meeting fund criteria, as said by two respondents; and
- a lack of confidence in the external party that approached with the idea – in their ability to be able to support the roll out of the solution or deliver on-time/to-budget.

Other reasons, each proffered by only an individual respondent, were:

- the ethos of the external party and of the DNO were incompatible;
- the project ideas did not fit into the portfolio of the DNO, avoiding internal duplication;
- the proposed ideas are under-developed, they will only work with parties to develop ideas like that if it is a very strong case from the outset or they have a good track record;
- the timing is incompatible – the skilled resources required from the DNO are already committed;
- technology readiness level - the project put forward was not at a high enough TRL to be a LCNF project; and
- the level of risk is unacceptably high.

A.1.3.2 Companies and Contacts that Approached

Some respondents provided the names of the organisations or details of the projects that they rejected, although some did not, citing Intellectual Property as the reason for not sharing.

Some examples of the reasons for rejecting proposals from third party organisations include projects that:

- were too similar to one undertaken by another DNO;
- required elements with high capital or upfront costs;
- were of too small a scale to be cost effective;
- required overly complex data requirement;
- would involve premature replacement of existing assets;

- the DNO believed an alternative solution would be a better or more cost effective way to achieve the solution;
- the DNO did not agree with the need for the solution proposed;
- did not comply with distribution network planning standards (ENA ER P2/6); and
- had not completed or shared learning from project with work already undertaken.

A.1.4 Sharing Learning (Q1.3.4)

Questions:
Please outline the processes you used to share learning from the LCNF trials

A.1.4.1 Methods of Dissemination

General Methods

All of the respondents mentioned similar dissemination methods. Project–specific dissemination events were mentioned by every respondent as a medium they utilised to share learning.

Three of the respondents provided several of their methods for knowledge sharing. The mediums that were utilised by the majority of these three respondents were:

- their innovation websites, containing project reports and updates;
- social media;
- articles published in the press;
- webinars;
- conferences (such as the LCNF conference);
- the ENA Smarter Network portal; and
- newsletters.

Stakeholder events/workshops were mentioned by two respondents. One of these respondents hosted workshops for stakeholders if the project is of a wider interest to a group of stakeholders.

One of the respondents also mentioned that they had articles published in journals such as IEEE and Applied Energy, and had a peer-review process at project closedown which has proven to be useful.

Another of the respondents actually visited the future networks teams of other DNOs to present their findings and the key implications for DNOs, they found this a useful exercise as they got feedback from colleagues dealing with similar challenges.

This same respondent found hosting technical sessions to be beneficial – meaning they could present their findings to experts in the field, can involve learning more on the specific technologies.

Knowledge Exchange Forum

Knowledge Exchange Forums were mentioned by one of the respondents. For one of their projects, CLNR, they created the Sustainability First Smart Demand Forum – this combined the knowledge from CLNR and customer-related projects, as business implementation can often require more than one project. The information from this forum fed into the Smart Grids Forum sub group investigating commercial and regulatory barriers for smart grids.

This same respondent hosted a dissemination event for those working in the same field when working on their 33kV super-conducting fault current limiter project, this allowed them to share their knowledge and develop a better understanding of the technology. Several of the attendees had not been directly involved in their or other industry projects, at that time.

A.1.4.2 Audience

One of the respondents highlighted their key stakeholders for learning derived from our innovation projects made up of various industry groups and including Ofgem; DECC; and wider government agencies; UK DNOs; the ENA; academic institutions; Association of Electricity Producers (AEP); Citizens Advice; and Smart Energy Demand Coalition (SEDC).

Another respondent split their audience into six group; internal, DNOs, energy industry, policy makers, academics, and the public – with other DNOs being their primary audience. They believed it was important to communicate with each group in the most appropriate manner.

A.1.5 Involvement of Third Parties (Q1.3.5)

Questions:
How has the involvement of third parties affected the breadth of innovation or success of the projects?

A.1.5.1 Summary of Responses

All the respondents felt the involvement of third parties had increased the breadth of innovation and actively contributed to the success of the projects.

One of the respondents elaborated on this to say that the third parties brought experience and knowledge from other international markets, resources financial and otherwise, capabilities not present in the DNOs, as well as a different perspective and thus different approaches to projects.

Another respondent commented that in all of their projects they ensure each partner is involved in at least one key milestone and deliverable.

Finally, one of the respondents felt that third parties have a positive impact if supervised/safeguarded by the network operator.

Third Parties Leading Projects

One of the respondents “hosted” a third party to lead a technology trial on our network as part of their I2EV project. They found this encouraged the evolution of new service delivery models.

Another of the respondents has had two projects this year with the third party that suggested the idea leading the project, they say they realise there must be a balance between them generating ideas and others coming to them with ideas.

Finally, one of the respondents feels that third parties leading projects could have a positive impact if supervised/safeguarded by the network operator.

A.1.6 Barriers That May Have Discouraged Project Partner Involvement (Q1.3.6)

Questions:
Are you aware of any barriers that may have discouraged project partner involvement?

A.1.6.1 Summary of Responses

All of the respondents were aware of barriers apart from one that felt they knew of no fundamental barriers to project partner involvement.

A.1.6.2 Intellectual Property Requirements

This was mentioned as barrier by two thirds of the respondents (four).

One of these respondents agrees with the requirements for new IP to be shared with all DNOs, but some partners, especially SMEs, cannot work with such a funding model. They have had an experience of an SME having to drop out as they felt they could not agree to the new requirements particularly with respect to background IP.

Another of these respondents feels that if you address the issues at an early stage they are manageable.

Finally, one of the respondents found it is only likely to be a barrier when the partner feels the IP of the project will be the primary provider of financial numeration.

A.1.6.3 Lack of Flexibility

The lack of flexibility in the LCNF was brought up by two respondents as an issue, with both commenting that with the nature of innovation i.e. an uncertain process, deviations are to be expected, and they feel the set-up of the LCNF is restrictive in that sense.

One of the respondents commented that for a deviation from the original bid, there is a change process that has the potential to expose all partners to risk. This leads to partners putting forward projects with a high degree of certainty that will not change, putting off those partners that are used to projects that adapt as they go.

The other respondent put forward their view that the 10% allowed variance on budget lines items is very restrictive, though they agree with the use of controls, they think that discourages parties entering as the need to keep the costs within the parameters would restrict the potential of the idea.

A.1.6.4 Funding Required from Partners

One of the respondents mentioned projects in which value is spread across the energy value chain where project partners have been required to contribute to the project funding proportional to the benefits expected should the project be successful. In a competitive market, with open IP as LCNF projects, there is not an opportunity for them to remunerate this money even when the project is successful. The same issue occurs in a regulated market is there is no allowance made for the funds. Missing out like that is always going to discourage a project partner.

Finally, one respondent felt that a financial contribution from partners at 10% is okay for larger organisations, but it can be a barrier for SMEs.

A.1.7 Benefits/Dis-benefits of LCNF (Q1.4.1)

Questions:
Please provide details of any indirect benefits/dis-benefits, or other impacts associated with LCNF as a whole?

A.1.7.1 Summary of Responses

All of the responses covered the benefits of the LCNF, with only one dis-benefit mentioned.

A.1.7.2 Within DNOs

Staff Development

One respondent remarked that the LCNF provided a good opportunity for development and training for their staff, with several members having their grade increased as a result of their new experience in areas such as project and delivery management, regulatory and customer care issues and designing new technologies.

Another respondent also felt that the LCNF had developed the skills of their staff and increased their experience with innovative technologies – when they take on a project it is their staff that must implement it allowing them to learn and gain invaluable experience they would not otherwise have. This staff knowledge and experience will prove to be essential when the transition to business as usual occurs.

This point was echoed by one of the other respondents in that they felt that as a result of the LCNF they have a deeper understanding of managing the technical and commercial risks and challenges that comes with innovative solutions. They believe the experience they have gained will allow them to both identify new solutions and spot the areas where solutions are required.

Cultural

One respondent mentioned the essential culture change needed to adapt to the changing nature of supply and demand for energy, with the LCNF being a part of that. They see this as a benefit as it highlights this need to make a change and drives them to do it, but obviously this comes with the dis-benefit that a large "ground shifting" change is required in order to do it. They say the awareness has definitely increased and there is Senior Management support for it now.

A.1.7.3 Strong and Successful Partnerships

One of the respondents felt it has formed successful partnerships that can actually create value beyond the project, but with the LCNF as the origin. In some of the examples provided, companies have continued on their partnership following the project – and in some instances investing in new work and assets.

Another respondent has found these partnerships have established a strong communication link with commercially driven organisations, and thus they can go to the market with problems in a more collaborative manner.

A.1.7.4 Other Benefits

One of the respondents commented on the increased amount of customer engagement they have had as a result of their projects – they have been given an insight into how their customers view them and their services.

Another respondent identified several benefits, as detailed in the following paragraphs.

They made the point that LCNF projects have provided policy guidance or evidence for the energy and climate change select committee. This type of input can inform the political understanding and recognition of the value of smart grids.

A further benefit identified in this response was the creation of a collaborative forum – saying that the business as usual solutions rolled out were usually a combination of several projects. They feel the establishing of area-specific forums has been very effective in producing solutions as it creates a pool of information and knowledge. They provided two examples of these forums; the Energy Storage Operators' Forum and the Sustainability First Smart Demand Forum.

This respondent also believes the LCNF has resulted in economic benefits to UK plc. – it has given companies an opportunity to develop their products and services, especially small and medium enterprises. As a result, a number of companies are now doing more work internationally.

The final benefit this respondent was aware of is the spin off processes and learning from data that has occurred. They identify an example of a spin off process – the Transform model – a tool which forecasts the spending profile required to prepare distribution networks for future uptake of low carbon technologies, which was successfully used at the ED1 price control view. It originated from bid preparation work in CLNR. This respondent believes that vast amounts of published data will be a great resource in the future for researchers.

A.2 Innovation in GB and Internationally

A.2.1 Would The Innovation Projects Have Occurred Without The LCNF (Q2.1)

Questions:
To what extent do you believe that these innovation projects would have occurred without the LCNF? Are you able to provide examples to support your views?

A.2.1.1 Summary of Responses

All of the respondents were of the view that the LCNF aided the projects occurring to a degree – two felt the majority would not have happened; three felt they would never have happened to the same scale and the remaining respondent felt that the fund definitely sped up the process of the projects coming to fruition.

One of the DNOs made the point that stimulation is needed for innovation to occur in a sector as regulated as the energy sector and this was in mind when the LCNF was initially set-up. They believe that not only would the projects not have occurred to the same scale sans LCNF; but also not to the same level of quality or scope. They believe this is especially true regarding long term, ambitious projects such as the CLNR – this would not have been taken forward.

Another respondent believed that the LCNF platform allows for dispensations and incentives to produce credible business cases for innovation projects.

Reduced Risk

Two of the DNOs mentioned that the reduced risk provided by the LCNF allowed projects that were previously hard to fund due to being risky i.e. beyond simple incremental innovation, the opportunity to be taken forward. ANM and CMZs were examples provided of riskier innovations that resulted in a change in approach. One of the respondents continued on to say the combination of the inventive of discretionary award (removing the risk of the initial decision) and rewarding the progression of business as usual, has made the LCNF successful.

Without the LCNF

Two respondents thought that only some of the technology in the projects that was at a high TRL would possibly have been invested in by DNOs without the LCNF, or delivered based on measures in the regulatory frameworks.

One of these respondents felt in addition to being high TRL to have any chance of being invested in without the LCNF, the solutions would have to be low risk in comparison to traditional solutions and result in direct cost reductions within the price review.

A.2.2 Effect of LCNF on Private Sector Innovation (Q2.2)

Questions:
Do you believe the LCNF has prevented, or otherwise discouraged, private sector innovation? Are you able to provide examples to support your view?

A.2.2.1 Summary of Responses

None of the respondents felt that the LCNF has in anyway discouraged or prevented private sector innovation. Two thirds of the DNOs felt that private section innovation has been increased as a result of the fund.

One of these respondents feels that this has led to innovation occurring in the areas which can deliver value to the consumer. Another of these respondents stated that figures indicated 94% of the fund spending has gone to the private sector. They also mention Innovate and Energy Systems Catapult as good innovative presences, giving innovation in the industry a sense of maturity.

The final respondent of this group believes the industry is becoming more welcoming to the private sector, as evidenced by two bids being submitted this year with a private sector company leading, championed by a DNO. DNOs also sponsor the Energy Innovation Centre – which helps SMEs promote innovative technical solutions that match the current issues of network operator’s.

However one respondent made the point that from companies’ regulatory returns it can be seen that the LCNF has not just replaced DNO’s existing price-control or shareholder-funded activities, it has extended them.

A.2.3 International Funding (Q2.3)

Questions:
What methods of innovation funding are you aware of internationally? How successful have overseas DNOs been in innovating, please provide examples where possible?

A.2.3.1 International Innovation Funding

Half of the respondents mentioned Horizon 2020 as the largest innovation fund in Europe. One respondent expanded to say the fund is nearly 80 billion Euros.

One respondent was aware of some US innovation funding – collaboration takes place through the Electric Power Research Institute and the Department of Energy also provides grants.

Another respondent has been involved in projects that actually utilised international funding. They were involved in an EU funded FP7 project, DISCERN, where the aim was to learn how to enhance the electricity network by using distributed intelligence. This project will help validate some of the NTVV project outputs.

The Aberdeen Hydrogen Project utilised three funds – EU (FCJHU), UK Government (Innovate UK) and funding from the Scottish Government. The final project the response covered was NINES – which involved providing new heating systems for 230 housing association properties – this was partly funded by a grant from the European ERDF fund.

This same respondent has found that although their experience with these funds has been positive, in general EU funded projects tend to be developed in response to a funding call on a specific topic which is different to the scope of the LCNF. They found the missing aspect of these sources was a good incentive to transition innovation to business as usual.

A.2.3.2 Success of International Innovation

One respondent that was aware of the US innovation funding had the example of NV Energy rolling out nearly 1.4m smart meters for customers residing in Nevada, with around half of the $280m cost being funded by a grant from the Department of Energy. This project had a dynamic pricing trial, consumer behavioural trial and provided operational benefits.

Another respondent has, as part of partnerships, reviewed internationally funded projects, implementing the learning into their own innovation strategy where possible both to avoid duplication and deliver value to their customers. They say they have provided statements of support for academic institutions previously to support their bid for internationally funded research when they feel it will benefit UK customers.

They are aware of international innovation projects that have brought benefits to the UK industry, through the learning and new products.

It is of the opinion of another respondent that international DNOs have had innovation success, and are most successful when they have specific network problems to solve. They provide the example of the rollout and control of energy storage in the state of California – this is being driven by the large amount of solar generation and the step change challenges between generation and demand.

A.2.3.3 Comparison with LCNF and the UK

One respondent mentioned The Smart Grid Projects Outlook 2014 by the EU Joint Research Centre on Smart Electricity Systems and Interoperability in which GB was ranked first in the 2014 ranking for demonstration and deployment projects, proving that funding through the regulator is a success. The respondent feels this proves how well the LCNF is working, and that the NIC should be kept at a similar level.

Another respondent mentioned smart grids – they feel that the UK is on a level with or ahead of other countries when it comes to the development of smart grid technology. They believe the LCNF has led to international interest.

Finally, one respondent stated that they have visited DNOs in America and Europe, and it is their view that the LCNF has been better at providing tangible value to customers than the mechanisms used internationally.

A.2.4 Gaps in Funding (Q2.4)

Questions:
What gaps or problems do you perceive in the present research funding arrangements in GB and Europe? Do these present a barrier to successful innovation? If so, how?

A.2.4.1 Summary of Responses

One respondent responded that they knew of no gaps or problems they wanted to highlight, and one respondent said they knew of no fundamental barriers to successful innovation.

A.2.4.2 Gaps in Funding Arrangements

One respondent feels there is a lack of funding for whole energy system trials i.e. involving the whole electricity value chain and cross-sector trials inclusive of electricity, heat and gas. They are aware of cross-sector projects struggling to meet the criteria for either LCNF funding or the resulting mechanisms in gas and transmissions, they believe this should be investigated to understand why these projects have not been created or not been awarded funding.

A.2.5 Barriers

A.2.5.1 Business as usual

One respondent feels an increase is needed in work that builds on the knowledge of completed projects to produce more learning and thus extract more value. They feel since it has become apparent that the implementation of one solution is normally as a result of several innovation projects, the pooling of the learning outcomes of projects could further increase the value created by projects. They feel there is two ways to do this; expecting more from individual projects i.e. knowledge exchange forums on topics, or looking for areas were the existing integration mediums could do more (ENA Smarter Networks Portal and the Energy Research Partnership as examples).

Another respondent feels that the dissemination process after successful trials could be utilised to identify the technology, policy and process change requirements to implement the solutions as business as usual.

A.2.5.2 Governance & Restrictions

One respondent highlight that the governance arrangements for each of the individual schemes have the potential to be incompatible, for example reporting requirements, intervention dates, match funding requirements and audit requirements. In their experience the process needs to be carefully managed to ensure funding is allocated correctly.

Another respondent mentions the restrictions of research funding – believing that there needs to be more "flexibility" considering the risky nature of innovation in order for the idea to be allowed the freedom to develop. They cite Innovate UK's approach as having elements of flexibility as it uses Early, Mid and Late awards which line up better with the development cycle of technology, and think the LCNF should utilise a similar approach.

A.2.5.3 Barriers of European Funding

One of the respondents states that European funding is not often utilised as it requires the forming of international supply chains and collaborations – resulting in increased costs and reducing the amount of learning that is actually relevant to the UK – and the funder may define the scope as opposed the network company.

Another respondent finds that the EU research funding is not always compatible timing-wise for LCNF projects, tier 2 in particular, as the EU funding is often allocated as a result of a specific funding call. This means DNOs would find it challenging to be able to use both the LCNF and external funding without taking on the risk of one of the funding applications being rejected.

A.2.5.4 NIC Barriers

One respondent believes that the evaluation criteria of the NIC fund needs to be altered, as they believe it makes it more challenging to proffer a project that may have a customer service or operating efficiency focus. For reference, the criteria they are referring to is as below;

a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits while having the potential to deliver net financial benefits to existing and/or future network customers

The criterion also specifies that the financial benefits must flow to network customers. They carry on – in a complex vast energy system project, benefits are likely to be shared more widely, and thus this criterion may stop a great project with potential to be a big success getting funded. They believe it should be reviewed and that all energy sectors costs can ultimately flow to customers in a well-structured market.

A.2.6 Additional Points

One respondent believes that innovation funding in the UK energy networks sector has been a success and has resulted in significant savings returned to customers through the price control mechanisms. They also feel the sharing of intellectual property has benefitted the whole sector. Another respondent feels this sharing of IP has created an impact, and they believe in the absence of the LCNF much of the innovation would never have occurred. This respondent also thinks the Ofgem LCNF fits in the innovation funding landscape.

A.3 Additional Comments

A.3.1 Additional Comments (Q3.1)

Questions:
Please make any additional comments in respect of the LCNF success or otherwise here.

A.3.1.1 On the Questionnaires

One respondent did not agree with the questionnaire's quantification of benefit being if projects have been adopted as business as usual, and if they have how quickly the transition was made. They agree it is important, though think this overlooks the fact that one of the key objectives of the funding was to promote learning, and does not reflect the value of more ambitious projects with longer lead times for implementation or where the benefits will be realised following ED1 when there is a higher take-up of low carbon technologies. Another respondent made the same point regarding some projects where the benefits will be delivered following ED1.

Another respondent made the point that they are aware of the tight timescale both Pöyry and Ofgem are under to complete this review, and they have tried to provide the best response they can considering the complexity and volume of information required – they were unable to carry out a full Data Assurance Guidelines compliant review due to the timescale.

Finally, one respondent stated that in their responses they have only mentioned LCNF project and solutions they believe are technically or commercially innovative, and that the data returns have been developed in a consistent manner and represent comparable data. They suggest carrying out a consistency review supported by the Energy Networks Association and UK DNOs as this would provide a more comparable view of the benefits of the fund to date.

A.3.1.2 Success of the Fund

Three of the respondents felt that the fund has been a success, making the point that the projects would not have occurred without the fund, with two of these commenting on how it has changed the DNO perception of innovation, now seeing it as a positive.

One of these feels the LCNF has completely changed the attitudes of all of the DNOs and their stakeholders; it has taught DNOs that innovation is beneficial and given them the confidence and the knowledge to invest in smarter solutions. They believe it has given SMEs and innovators a better understanding of the challenges in the sector and created an environment that promotes both innovation and business growth – they mentioned the EIC as a contributor to this, as the centre has interacted with many SMEs and innovators. They feel a further benefit of the LCNF is it allows the solutions to actually be tested on the network, not just in the realm of PhDs and labs.

Another of these respondents made the point that the ICI and the LCN Fund have not just stimulated innovation across the industry – but encouraged increased investment in research and development across the supply chain, and delivered value to consumers. This is proven as in their 'Well Justified Business Plan' for RIIO-ED1 they have identified savings of £129 million as a result of learning from their own and other's innovation projects; and savings of £180 million in ED2. They believe having innovation embedded in the regulatory framework benefits customers as Ofgem can benchmark and capture the savings for customers as a result of it. The respondent's final point was that the success of their innovation projects has led them to consider investing additional investor funds into innovation projects.

Following on from that, one respondent stated that in the RIIO ED1 price control Ofgem identified £963m of savings that could be realised by the DNOs through Smart Grid savings and innovation. They feel for this to be achieved the DNOs will need to utilise LCNF learnings and make use of innovation funding mechanisms in RIIO price controls.

Benefits

As mentioned above, one of the respondents did not agree with the quantification of the benefits according to the questionnaire. This respondent provided two examples of their own projects where the learning could prove to be significant between 2020 and 2050, even if having not provided any quantitative benefits to date.

Their first example of this is the CLNR project in which they implemented a large number of heat pumps and monitored their electrical characteristics and ability to peak shift. They found that though the heat pumps reduced customer peak load by 2.5kW; there were real barriers such as the requirement to retrofit pumps and the associated thermal store into domestic properties – installations would be expensive, require insulation, require physical space and cause disruption. So though the project could not go ahead they believe the learning from it helped shape the GB renewable heat strategy. They continued on saying the learning is also being used to aid the Smart Systems and Heat project Energy Systems Catapult is carrying out.

The My Electric Avenue project was mentioned in that although it has not provided quantitative benefits to date the project tested technology that could control charging times on the network, and that this technology could not be implemented without input from the motor industry, which is occurring in a follow-on project.

Business as usual

One of the respondents mentioned their Constraint Managed Zones project as an example of a business as usual initiative as result of the LCNF – it is a culmination of learning from various LCNF projects they undertook.

Another respondent is of the view that the learning resulted from projects requires further real life testing before it is put into business as usual – they see the primary aim of a DNO as servicing their customers so rigorous testing is required to ensure the technology used in trials is as effective in real life.

A.3.1.3 Continuing Progress

One of the respondents stressed the importance of the support for innovation continuing to ensure the progress the industry has made is maintained and that the benefits from ongoing projects are delivered. They also know that the DNOs have a responsibility to ensure the projects are transitioned to business as usual as quickly as is possible.

The respondent believes that with the upcoming challenges in the industry including the increasing use of low carbon technologies, the network operators will need to be able to innovate in order to adapt. In their experience their best solutions, CMZ and ANM, have been an amalgamation of learning from across their innovation projects – so they think being able to maintain a wide range of projects is important.

A.3.1.4 Suggestions

Governance

One of the respondents feels it could be beneficial for the funding to be changed so it does not need to be used within the year, as some NIA projects may span several years – instead they suggest having a carry forward mechanism for funds unspent in the previous years, as the IFI had.

This respondent also feels governance could be changed to take into account projects where benefits are shared across the whole system (i.e. between transmission, supply and distribution) so there is a broader view of the benefits, in order to encourage funding applications for these projects. They believe if the market is structured well, all energy sector costs can ultimately flow to customers.

Another suggestion in this response was having more flexible IPR governance as they believe this may have been a barrier somewhat to obtaining third party funding for projects, believing the contributions could have been larger with more flexibility. They feel having a body such as the NIC Expert Panel to agree the most appropriate IPR arrangements for each project could be beneficial.

Their final suggestion is that the review should include the identification of obstacles to adoption and how to remove them – this will show how effective the Innovation Rollout Mechanism is at transforming innovation learning into business as usual.

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ANNEX B – RESPONSES OF PROJECT PARTNERS

B.1 Success of the LCNF

B.1.1 LCNF Meeting its Objectives Regarding Innovation as Business as usual (Q1.1)

Questions:
Do you believe that the LCNF has met its objective in incentivising the DNOs to include innovation as part of their core business?
What justification do you have for your response?

B.1.1.1 Summary of Responses

The general consensus was positive in that over half of the respondents that replied to this question felt that the LCNF had met the objective. One respondent commented on the difficulty of convincing DNOs to trial any new concepts previous to the LCNF if the financial return was not obvious.

The main point that can be taken from the responses to this question is that although the LCNF has definitely incentivised DNOs to be more innovative, work still needs done to ensure more projects progress from the trial stage to business as usual.

Some respondents think that the objective been partially met – but it is too early for the full effects to be realised regarding including innovation as business as usual.

B.1.1.2 Positive Responses

A respondent pointed out a good example one of the projects that has transitioned to business as usual, referring to UKPN Plug and Play. As a result of the project several DNOs have been rolling out Active Network Management schemes allowing easier connection of distributed generation (wind or solar generation) to the network. Two respondents mention that the LCNF was essential for the DNOs to meet the RIIO-ED1 targets.

Three respondents the degree of learning that has emerged as a result of the LCNF. Another respondent made a similar point mentioned how useful that disclosure of the project outcomes, plans and annual progress reports are as sources of information. The response carries on to say that some DNOs have included the implementation of successful outcomes from completed projects in their RIIO ED1 plans, with ANM being one of these.

One respondent stated that there has been a positive culture change – continuing on to say that there has a been a major shift towards innovation with DNOs now more open to change where there is a business benefit. This same respondent also believed that having the regulator drive the LCNF has been beneficial in helping companywide buy-in, focus and purpose to innovation projects.

B.1.1.3 Challenges to meeting the objective

A reservation of a quarter of respondents was the lack of ideas that have been fully adopted into business as usual. One of these respondents pointed out that one of the challenges is balancing the costs of change with the cost of integration into the current system.

The change in the culture at DNOs was mentioned in several responses. One respondent's thoughts were that the LCNF has started progress towards a more innovative culture within DNOs but there was still a long way to go before the change is completed. Another respondent stated that there has definitely been a positive culture change, but that this culture has developed with a focus on innovation but not commercial viability due to the fund "safety net", thus very few of the trials have come to fruition.

Finally, one respondent believed that in some cases the DNOs use the fund because it is there, but this does not mean there was a change in their core views on innovation.

B.1.1.4 Other points

One respondent made the point that although the DNOs have undertaken innovative activities as a result of the LCNF, it is not clear if they are now undertaking innovation as funded by their stakeholders. The point of investing in innovation is to benefit your company and thus gain advantage over your competitors – they do not expect networks will share information publicly on any innovative activities they carry out as they will want to gain this advantage.

B.1.2 LCNF Meeting its Objectives Regarding Low Carbon (Q1.2)

Questions:
Do you believe that the LCNF has met its objective of helping the DNOs move towards a low carbon business whilst maintaining security of supply and delivering value for money to customers? What justification do you have for your response?

B.1.2.1 Summary of Responses

Half of the respondents (ten) believe that the LCNF has met this objective, with two respondents not providing an answer.

One respondent believed it has partially – though new technology has been developed it is in inconclusive whether the projects themselves have led to lower carbon. But they felt that this new technology has been used to assist low carbon operations by others – using storage to improve wind and solar connections was provided as an example of this.

Another respondent made the point that some of the projects it is aware of, this is true and the objectives are met, but they are unsure on larger ones where the project design is more questionable.

B.1.2.2 Connections to the Network

Several respondents mentioned connections – with three respondents mentioning improved distributed generation connections, and one respondent stating that the LCNF has provided increased connections of low carbon generation, assumedly through distributed generation.

One respondent commented on the number of connection that have gone ahead as a result of the LCNF but would not have otherwise. Another respondent discussed the use of ANM to deliver value for money for generation customers by providing fast and inexpensive network connections – once again relating to the improved distributed generation connections. Finally, a respondent stated that the LCNF has provided increased connections of low carbon generation.

B.1.2.3 Barriers to Meeting the Objective

One respondent stated their disappointment regarding ideas that have been trialled not then advanced to business as usual, as they had previously mentioned in their answer to the previous question. They make a point that the trials were rolled out at the wrong times, but concede that it is difficult to perfect the timing. They also feel that if the trials for the DCC and SMETS 2 meters had been rolled out at scale it would have increased the chance of the trials leading to business as usual products, in a cost-effective manner. Another major concern is that a lot of the knowledge gained from the LCNF will not be utilised within the DNO businesses. In conclusion, they felt the knowledge gained supports security of supply and value, thus the trials have been beneficial for GB PLC.

Another respondent listed a range of issues regarding meeting the low carbon objectives. One being DNOs trying to adapt new technologies under restraints from regulatory authorities and their positive in the energy market, they gave the example of the CLNR project which involved using differential tariff structures – this does not suit Ofgem as they strive for simple and lean tariffs. The response went onto say this will lead to a slow transition. Another issue mentioned by the same respondent was the lack of knowledge share between DNO's – as due to the competitive nature of the operators. Another response pointed out that this transition to low carbon is not just dependent on the DNOs – it relies on third parties – low carbon generation being a good example of this.

Finally, one respondent stated that the drive for low carbon solutions waned as the LCNF went on.

B.1.2.4 RIIO Regulatory Framework

Two respondents mentioned RIIO. The first one suggested that the value of money aspect will need to be monitored over time when projects are rolled out to customers. They noted that this value for money is obviously linked to the efficiency and value gained from innovation as submitted in RIIO-ED1 business plans and it will now be interesting to find out the extent to which that value is actually delivered through ED1 and beyond. Secondly, a respondent felt that it was not the LCNF directly that led DNOs towards a low carbon business – it merely aided the move, it was the RIIO that actually achieved the objective.

B.1.2.5 Other Points

The response of the one respondent stated that there is definite potential as National Grid has looked into the probability of a number of solutions being implemented; finding that in some cases further work would be required before full implementation could occur. CLASS is one of the projects they evaluated the potential of that would require further technical work before implementation – but the outcomes of CLASS are informing part of the joint National Grid and UK Power Networks 2016 NIC project TDI 2.0, a project for the south of England where the transfer of solutions like those developed and proven under CLASS is a current focus.

B.1.3 LCNF Meeting its Objectives Regarding Low Carbon and Energy Saving Initiatives (Q1.3)

Questions:
Do you believe that the LCNF has met its objective of helping the DNOs facilitate low carbon and energy saving initiatives? What justification do you have for your response?

B.1.3.1 Summary of Responses

Seven of the respondents felt that the LCNF has met these objectives; with eight other respondents feeling it has been partially met.

Five respondents provided no comment for this question.

B.1.3.2 Facilitating Low Carbon Initiatives

Several respondents responded positively regarding the facilitation of low carbon initiatives. One respondent mentioned that through their projects the DNOs have been learning about facilitating low carbon transportation. Three respondents discussed how the LCNF has allowed DNOs to connect greater volumes of low carbon generation to the network, with one respondent also citing the connection of greater volumes of lower carbon demand i.e. electric cars.

Another respondent made the point that only some of the trials for low carbon enabler technology showed potential for future use, it will take time for this technology to be established and in BAU activities.

B.1.3.3 Energy Saving Initiatives

The responses regarding energy saving initiatives was less conclusive. One respondent questioned whether having that as an objective was thought-through, as although DNOs are rightly pushed to achieve a high network utilisation this must lead to increased power losses. According to another respondent although the LCNF has aided DNOs in low carbon initiatives, it has not focussed on energy saving initiatives to the same degree.

Finally, one response pointed out that energy saving initiatives are more likely to occur on the demand side – independent from the DNO. Though through the LCNF the DNO has supported projects involving customer participation, thus it has met the objectives in this area.

B.1.3.4 Other Points

A few respondents make the point that it is too soon to tell. With one respondent saying that a longer time period is needed to ensure a god proportion of the new ideas have been transferred to BAU.

B.1.4 LCNF Meeting its Objective Regarding the Dissemination Of Learning To Facilitate Roll-Out Of Successful Trials (Q1.4)

Questions:
Do you believe that the LCNF has met its objective of the dissemination of learning to facilitate roll-out of successful trials? Are you able to provide examples to support your view?
Are you aware of learning being implemented from trials by other DNOs as well as their own? Are you able to provide examples to support your views?

B.1.4.1 Summary of Responses

All of the respondents that replied to this part of questionnaire felt that the LCNF has met its dissemination objective, two respondents did not reply.

B.1.4.2 Successful Dissemination

As mentioned, nearly all of the respondents agreed on the fact that the dissemination has been good. This has been through various mediums – individual project events, videos, webinars, detailed reports, conference papers, LCNI conference, industry conferences and workshops. Two respondents commented that the LCNI conference is particularly good for dissemination of knowledge purposes.

Two respondents mentioned how the dissemination has not only been to DNOs but across the industry – one of these says that DNOs have been able to spread the knowledge across the wider energy population, and the other mentions a number of conference papers that have been presented to the industry. Another respondent somewhat disagreed with this, saying the dissemination was not as good beyond the DNO community.

One of the respondents pin-pointed UKPN Low Carbon London and FPP learning reports as highly regarded and of a “benchmark” standard. They mention that other DNO’s, SSE for example, have made good use of targeted webinars. They note that the roll-out of innovation projects is only really addressed right at the end the project trials, and possibly some mechanism to support implementation into the business post-trial would be very helpful.

The quarterly working group of the R&D Managers in which they share information on completed LCNF/NIA/NIC projects was mentioned as good practice. The respondent suggested further coordination between the networks as a good idea in order to host some joint themed dissemination events, thus enabling technical specialists to gain insight from relevant projects but from fewer, more focussed events.

B.1.4.3 Roll-Out

One respondent stated that the dissemination from the Electric Boulevards project led to a better understanding which aided the further roll-out of the project in London.

B.1.4.4 Learning from Trials from Other DNO’s

The responses to this part of the question were mixed, with more positive than negative.

Six respondents were unaware of any examples of DNOs learning from the trials of other DNOs.

On the other hand, half of the respondents (ten) were aware of examples of DNOs implementing learning from other DNOs' trials not just their own. One respondent gave the examples of UKPN using experience from other LCNF projects including storage for their own project, and NPG utilising the outcome of WPD, SSEPD and UKPN trials to build aspects of their CLNR.

Another example provided by a respondent is DSR where a lot of knowledge from LCL and FALCON is being utilised by DNOs. A further example was given by another respondent – WPD utilised available information on similar projects both as part of the project and post-project reviews. Another respondent had an example of DNOs utilising the trial of another DNO – several DNOS adapted the ANM co-developed and trialled with SHEPD in the Orkney Smart Grid program, though they did then run their own trials.

One of the other respondents was aware of other DNOs using the primary transformer ratings based on the SPEN Flexible Networks project.

One respondent mentioned that the outcomes of CLASS will be informing part of the joint National Grid and UK Power Networks 2016 NIC project TDI 2.0, and that Active Network Management (in several LCNF projects) is being adopted by a number of DNOs. They went on to say they believe that trial outcomes have provided an insight into the additional work needed to consider both system wide implications and the particular circumstances of different network areas – solutions that work in one area won't necessarily be beneficial in another.

Finally, one respondent made the point that DNOs often say they find it easier to implement learning from their own projects into BAU, but actually adopting the learning of trials that were not yours comes with a reduced risk and cost savings. Also say that different DNOs have different processes for identifying opportunities and delivering innovation.

Competition between DNO's

A quarter of the respondents felt competition between DNOs was having a negative impact on the success of the LCNF.

One respondent made the point that it is possible that DNOs are prioritising their own LCNF projects to maximise value internally. The respondent went on to say that in the future the most successful projects, "winners", will become clear and there will be publicly available information DNOs can access.

One of the respondents believes that there are few examples of DNOs implementing any knowledge from the project of another DNO, believing this is due to competition between DNOs and that it is not their idea meaning it is harder to bring about change. Another respondent made a point about competition between DNOs – stating that the competitive element should be reduced so DNOs feel they can share the truth about the project instead of trying to project that everything went perfectly. They also state that there may be evidence of DNOs working more collaboratively under RIIO where they have a good 'fit'.

Competition was mentioned by another respondent– they believe that a lot of the work carried out could have been performed better through collaboration or at least co-ordination, rather than the competition driving the DNOs apart.

B.1.5 LCNF Meeting its Objective Regarding Effective Collaboration Between DNOs and Project Partners (Q1.5)

Questions:
Do you believe that the LCNF has met its objective of effective collaboration between the DNOs and project partners? Where appropriate please provide evidence of the success, or otherwise, of collaboration.

B.1.5.1 Summary of Responses

The general consensus from the respondents was that the LCNF has met this objective, with nearly three quarters of them agreeing on this.

B.1.5.2 Positive Responses

Seven respondents spoke positively of the collaboration between project partners and the DNOs, stating it was done effectively and successfully. The consensus was that the collaboration was greatly improved compared to prior to the introduction of the LCNF, with one respondent commenting that there was virtually no collaboration previous to the fund. One of the respondents in this group made the point that it has led to good knowledge transfer across the business units within DNOs as well as external parties.

Finally, one respondent noted that individual and management team members at DNOs have embraced the required new skillset as part of the LCNF projects – research methodology, real partnering (rather than supplier procurement), idea generation and filtering, open innovation, trial implementation, learning capture and dissemination, programme evaluation, innovation business adoption, etc. They believe this cultural shift is an ongoing and essential change for the DNOs.

B.1.5.3 Examples of Good Collaboration

One respondent highlighted the collaboration between WPD, TRL and ADL as part of the Electric Boulevards project was deemed successful, resulting in a good understanding of the effect of electric bus operation on the network.

Another respondent also provided the example of the CLNR project in which good collaborative working was required to enable project completion – involved new ways of working, vocabulary and understanding between partners.

Project Falcon was mentioned by a respondent as an example of a good collaborative team.

Another respondent mentioned Electric Avenue as successful collaboration, as well as CLNR using learning from LCL regarding Distribution Management Systems and interaction with WPD regarding LV Network templates.

One respondent commended the DNOs on their contributions to the projects REACT and DIVIDE. They believe their position as system operator made their partnership with ENWL on CLASS added value to the outcome as it could be considered by the system operator, and they will continue to be as involved in collaboration as they can be.

Finally, one respondent felt they collaborated well with SPEN, WPD and ENWL – finding the experience broadening and not something they could have done before.

B.1.5.4 Reservations

One respondent, made an observation that partners sometimes are unaware of the amount of work and commitment required for the projects, which really comes into play at the end of the project when they are limited on time or interest. They feel if OFGEM gave more information regarding the exact project requirements it could hopefully avoid this in the future. They also think it should be made clearer what exactly the fund is i.e. an adjustment to allowable revenue as opposed to a money pot.

Another respondent thought that the objective had only been partially met – but collaboration has definitely improved as many DNO managers are in constant communication with each other. Their concern is that the now experienced staff members are not lost due to the usual routes, and if they are that it is ensured new staff members are properly informed on the LCNF.

It was the view of one respondent that the collaboration is not as great as people like to believe, but DNOs actually conduct themselves more like competitors.

Finally, another respondent believed that the collaborative aspects have been carried out to varying degrees of success. They say this is down to the complexities of the LCNF bidding process and the governance of the project, as this puts constraints on the way the project partners operate. They think that this may not be the most efficient way to deliver an innovation project.

B.1.6 Barriers that Affected the Outcome of the Project (Q1.6)

Questions:
Are you aware of any barriers that may have affected the outcome of the projects?

B.1.6.1 Summary of Responses

There were six respondents that stated that they knew of no barriers that may have affected the outcome of the projects. The others commented on the barriers that affected the projects they were involved in, with only two respondents not answering the question.

B.1.6.2 Customer Engagement

A fifth of the respondents highlighted customer engagement as a barrier, as it is not an area DNOs have usually been active in, as this is usually mediated by retailers as pointed out by a respondent. The issue was the difficulty in getting the participation of consumers. One respondent pointed out that DNOs would often make naïve assumptions regarding offers that would appeal to customers, often choosing the wrong ones.

B.1.6.3 Governance

Governance was another barrier mentioned by several respondents. One respondent gave their views of the governance of Tier 2 projects – saying it was a definite barrier and the focus on value for money for customers meant the projects became very risk averse leading to concepts become less innovative. They say the Tier 2 bids from year 2 onwards are evidence of this. They say it was clear from the DNOs that they had struggled during the change control process with Ofgem, meaning they were hesitant to develop any projects with a less than high certain outcome. They continue on to say they think this has created irreversible damage to the Tier 2 (now NIC) network innovation programme.

The complexity of the bid preparation and submission process was mentioned by one respondent stating it requires a range of resources, continuing on to say that the process could have been more efficient if it weren't for various governance requirements and numerous review rounds (ISP, final bid, Q&A process, interrogation report, two expert panel meetings).

Finally, one respondent stated that Ofgem set unreasonable project constraints, giving EATL's My Electric Avenue as an example of this.

B.1.6.4 Other Barriers

Various other barriers were mentioned by the project partners that responded. These are listed below:

- concerns for the treatment of Intellectual Property, as stated by one respondent;
- barriers in the CLNR project were mentioned by two respondents;
  - one respondent mentioned supplier ownership of data as a problem as they feel data collected with public money should be public – so the collection then disposal of the data at the end of the project was a design failure; and
  - another respondent mentioned the lack of EVs on the road at the time of the project an issue, as well as the lack of DSR value (peak and off peak differential).
- the nature of the project (research and development) makes it less predictable and thus more chance of unforeseen issues occurring, as pointed out by one respondent continuing on to say this is why projects like FALCON are key to show proof of concept and a path forward;
- another respondent makes a point that some projects may have external dependencies (SMIP for example) and these need to be properly understood in order to be managed properly;
- internal resistance to change/inherent conservatism;
- training and replicate learning;
- lack of resource;
- economics; and
- strategic fit.

Also one respondent felt it was telling that not all of the money was spent – this suggests that DNOs were short of viable ideas – showing a lack of resource or initiative for DNOs to look externally.

B.1.7 Barriers That May Have Discouraged Project Partner Involvement (Q1.7)

Questions:
Are you aware of any barriers that may have discouraged project partner involvement?

B.1.7.1 Summary of Responses

The majority of respondents were aware of barriers that discouraged project partner involvement, but five respondents said they knew of no barriers. Two respondents did not pass comment.

B.1.7.2 Intellectual Property

Intellectual property was highlighted by three respondents as a barrier – one respondent mentioned that the IPR arrangements make it more difficult for certain types of partner to be involved, one of the other respondents mentioned that it would be an obvious barrier but they have not actually found it to be a significant barrier for them.

B.1.7.3 Bureaucracy

Bureaucracy was mentioned by three respondents. One respondent said the ever-increasing bureaucracy of applications and project management was the main barrier – regulators have no incentives to eliminate any rules or procedures, only to do the opposite. There is also no incentive to take measured risks. The other respondent agreed that the biggest barrier has been the governance structure of the LCNF – singling out the main issue as being the lack of flexibility with regard to any deviation from original plans. They think flexibility is key to innovation.

B.1.7.4 Partner Selection

Two respondents said that the trusted partnerships – DNOs choosing partners they had worked with before – became a barrier to project partner involvement. One of these respondents commented that in later rounds it became a tender for partners, as opposed to DNOs selecting teams based on skills. The other respondent went on to discuss the changing of the process – it became a business as usual procurement led process meaning the focus was on price and risk – thus not supporting an ‘investment’ approach by project partners and making the engagement become a supplier relationship. They believed the focus on value for money was detrimental to the value the project partner could bring – fed this back to Ofgem early 2015.

B.1.7.5 Difficult for Smaller Companies

The barriers for small companies were brought up by two respondents. One respondent commented that it would be harder for small companies rather than SME and micro enterprises since funds for business development are restricted. The other respondent said that the obvious challenges (IP terms, significant partner contribution expectations, lack of upside in SDRC commitments) seemed to be overcome by many project partners, with the exception of smaller companies which may have found it difficult to contribute to LCNF projects.

B.1.7.6 DNO Related Barriers

One respondent mentioned DNO’s lack of resources/manpower as a barrier – saying that they heard some DNOs did not bid one year due to this issue. This point was agreed with somewhat by another respondent that identified DNO’s tight budgets as a barrier, continuing on to say the set objectives of DSOs also made it difficult.

B.1.7.7 Other Barriers

Various other barriers were mentioned by respondents, as below:

- one respondent pointed out that only the DNOs being able to propose projects limited the number of project suggestions and how ambitious the projects were;
- another respondent commented that the lack of SMETS 2 and DCC was a barrier;
- a respondent commented on the difficulty of gaining interaction with LCNF battery projects, even post-completion; and

- finally, one respondent felt DNO interpretation of financial management rules can be counter-productive – had to wait 9 – 16 months for major bills to be paid on a project, this was not true for all projects

B.1.8 Parts Of The LCNF Which Have Worked Or Not Worked (Q1.8)

Questions:
In your view, which parts of the LCNF have worked well and which haven't? What would you change in retrospect and why?

B.1.8.1 Summary of Responses

The responses to this part of the questionnaire were extremely varied, with a wide mix of views and suggestions.

B.1.8.2 LCNF Successful Aspects

Two respondents commented on the creation of discussion and a knowledge pool between different levels of the industry. One of these respondents and one other made the same point that the LCNF has allowed an array of innovative projects to be carried out that would not have been possible otherwise. With another respondent calling the LCNF a watershed in the industry, leading the UK to become an established global leader when it comes to smart networks innovation – they praised Ofgem and the UK government for their leadership.

Finally, one respondent commented on the improvement of DNOs in proposing innovative projects. They say that initially the proposals were conservative, involved a limited number of companies and the DNO was hesitant to receive any suggestions from SMEs – but this has changed.

B.1.8.3 LCNF Less Successful Aspects

One respondent mentioned that they contributed to the funding (overhead and personnel costs) but it would have been better if they had been fully funded, as they are unsure of any future benefits to them of having contributed financially.

Another respondent pointed out the importance of the requirement to have appropriate partners involved, as on CLNR they feel econometricians should have been involved.

Other aspects one respondent had issue with were the slowness of the roll-out into BAU and the limited understanding of DNOs of DSR, they thought it essential that DNOs start to take note of DSR aggregators' experience in designing customer proposals.

One response suggested that even though DNOs and other organisations in the industry are learning from these projects, it does not necessarily mean that the government and regulatory authorities will take these into account in reshaping the energy system to become fit for transitioning to a low carbon economy. The regulator would need to learn how to manage the risks of R&D projects as well as how to take projects from the trial stage through to the business as usual stage. Also they must understand that not all successful trials are appropriate to be rolled out across the UK, as several projects and their associated business cases are local site specific.

Another respondent felt the issue can sometimes be the DNOs not having the resources (people) to take advantage of all the opportunities the LCNF produces.

Finally, a respondent stated their disagreement with the argument that "innovation incentives have done their job" – meaning that innovation should be part of business as usual with no specific treatment as this would be ignoring the differences between innovation projects and traditional investments.

B.1.8.4 LCNF Suggested Changes in Retrospect

One respondent suggested the change request process needs changed, as for any simple changes it should be almost self-certifying. They suggest for large budget changes a two stage award could be considered so design could be finished before proceeding, believing this could also help in cases where budgeting is wrong – from being underestimated or otherwise – so funding could be stopped before too much funding has been released.

One respondent commented on how the Tier 2 projects seemed to get pushed into the limelight somewhat leaving the Tier 1 projects behind even during the LCNF conferences. They continued on to say this was a mistake as it stalled innovation somewhat as the focus was put onto "flagship" projects. They believe that as RIIO-ED1 progresses the Network Innovation Allowance will become increasingly important as some DNOs currently are in no position to deliver a sustainable innovation programme presently, they think the DNOs were not sufficiently encouraged by Ofgem to get these aspects in order. Another point in this response was that the dogmatic governance in Tier 2 Projects led to DNOs and those in the supply chain disengaging somewhat and project partner opportunities becoming fewer.

One of the respondents made a point regarding the partner collaboration, saying that there have been a number of unusual attitudes and behaviours towards many aspects from the selection process to partner rights/responsibilities. They think that establishing good practice with relation to partners, and distinguishing partners from procured suppliers would be worthwhile. There was a similar point made regarding partners and suppliers in the previous question. This response also noted that clarification around IP would be beneficial as several issues have occurred during LCNF projects as a result of IP topics, listing; background IP vs. foreground, contributions to invention and IP (to reflect UK patent law), rights to use/exploit beyond the project, costs for protection of IP generated in LCNF projects (registered IP vs. unregistered IP), differentiation between IP created through the UK customer account and the supplier's shareholder account, IP publication rights, shared IP, DNO exploitation of IP created/retained through LCNF projects (as per the default IP terms in LCNF) in which part of the project. They believe an open discussion on innovation programme IP would be beneficial so all parties are informed.

7.3.1.1 Project Selection Process

One respondent believes that the need for projects to show guaranteed benefits, quantifiable at the proposal stage, hinders the ambition of the projects as this produces an increased requirement to be risk-free. This point has been made previously by respondents in responses to other questions.

Another response suggested that Ofgem could have provided direction in the final years of the LCNF to encourage projects in specific areas, rather that leaving it open to the DNOs, as this could have brought in quality targeted proposals and encouraged competition. They feel the diverse nature of the project proposals must have made it more difficult for the Expert Panel to make a comparative assessment.

A further point from the same respondent was on the Initial Screening process – they say that this should be changed so that the success criteria is more robust with an honest appraisal of the chance of success at this stage – as this will avoid significant cost and loss of confidence in the process.

Finally, one respondent believed that the LCNF funded projects that are not favourable in a business as usual environment, may work in an innovative environment.

B.2 Innovation in GB

B.2.1 Would The Innovation Projects Have Occurred Without The LCNF (Q2.1)

Questions:
To what extent do you believe that these innovation projects would have occurred without the LCNF? Are you able to provide examples to support your views?

B.2.1.1 Summary of Responses

All of the respondents bar two stated that the innovation projects would not have occurred without the LCNF or otherwise that the projects would not have occurred in such a quick timeframe or at the same scale without the LCNF.

B.2.1.2 Timeframe and Scale

Six respondents felt that the LCNF has definitely sped up the execution of these projects.

Two respondents believed innovation projects could not have been undertaken at to the same scale without the LCNF.

B.2.1.3 Knowledge Dissemination and Innovation Culture

One respondent made the point that it is not just the funding that aided the projects – it is the generation of an innovation culture. It was also mentioned by respondents that the LCNF created a good knowledge share culture within the industry, including between DNOs. One of these respondents also mentioned the increase in knowledge transfer internally in DNOs. The LCNF encourages the DNOs and their project partners to look into increasingly innovative solutions than they ever would have otherwise – as agreed with by a respondent.

B.2.1.4 Funding

A quarter of respondents pointed out that the projects could not have been funded without the LCNF, with one respondent commenting that looking at storage examples most of these would not have been able to be self-funded as the initial cap ex was around 10 – 30% too high. Another respondent states they could not see how the projects could have begun without the funding in place to encourage collaboration between DNOs and their partners.

A respondent mentioned an innovative (LCNF type) bus project put together prior to the fund by Arup-Mitsui – so they think some focus should have been put on encouraging the local authorities and DNOs to facilitate unfunded projects.

Finally, one respondent commented that without funding the networks would have to go for low-risk innovation options, as it would require network shareholder investment.

B.2.1.5 Regulatory Measures

Two respondents said how the LCNF led to there being a greater chance of relaxation of regulatory measures; in order for innovation projects to take place e.g. Smarter Network Storage by UKPN.

Another respondent commented on the regulatory regime. Although it is significantly different now under RIIO, the timescales over which the price controls operate are still too short for most but the simplest ‘easy wins’ to be able to be implemented and make a return in eight years to justify the investment necessary for many of the LCNF projects that have advanced.

B.2.1.6 Previous to the LCNF

Several respondents commented on how innovation was sparse within DNOs prior to the LCNF. One respondent mentioned Ofgem’s innovation incentives, IFI and RPZ, and how they brought forward significant products. This respondent also commented on the great job Ofgem did to upscale these incentives with the LCNF scheme. Another respondent commented on how it has given DNOs an opportunity to use resources on activities out with business as usual, which has been liberating for both DNOs and project partners, who enjoy being able to ask more from DNOs support wise.

Another respondent commented that many departments relating to power engineering have closed down in the past twenty years due to a lack of interest or funding from DNO’s to undertake innovative projects and fund research centres.

Another respondent mentioned that prior to the LCNF DNO innovation was rare and it was more likely that a DNO would block innovation than encourage it – but obviously since the LCNF this has totally changed.

B.2.1.7 Other Observations

One respondent made the point that LCNF has not only funded innovation it has provided a mechanism to reward adoption and roll-out in subsequent price controls. The innovation roll-out mechanism under RIIO-ED1 now provides the opportunity to fund roll-out for new solutions within the same price control period.

B.2.2 Effect of LCNF on Private Sector Innovation (Q2.2)

Questions:
Do you believe the LCNF has prevented, or otherwise discouraged, private sector innovation? Are you able to provide examples to support your view?

B.2.2.1 Summary of Responses

None of the respondents thought that the LCNF had actively prevented or discouraged private sector innovation, or had any examples of this.

B.2.2.2 Encouraged Innovation

Six of the respondents believed that the LCNF has in fact encouraged private sector innovation.

One respondent stated that prior to the LCNF the combination of the industry being reliant on private sector (shareholder) funding for innovation, IFI mechanisms and the nature of the regulatory regime that existed then, led to reduced innovation in the networks. But that the fund has changed this.

One respondent commented that they used each LCNF project as an opportunity to invest in R&D, as well as taking the outcomes of the projects towards becoming standard products and services. They also say the LCNF gave new and smaller enterprises an opportunity to participate in trials. This was agreed with by another respondent - the response continues on to say that the LCNF and the learning outcomes led the market in a clear direction – and that this trend and the associated product/service requirements has given the private enterprises direction, and something to respond to. They say this must be done with caution though as the LCNF does not guarantee a developing normal market or a timeframe for it to happen.

Another respondent says that the commitment of the LCNF to the UK smart grid will provide further opportunities for innovation.

Finally, one respondent believes that the private sector has welcomed the opportunity provided by the LCNF to collaborate with the DNOs, and the benefit that comes from the learning outcomes being shared between the DNOs i.e. exposure to a wider customer base. This knowledge of DNO's requirements means private sector companies can cater products/services that more suit the DNO requirements, and have a better idea of what is possible or not regarding innovative technology. They do concede that focussing on the BAU potential of the projects possibly discourages lower TRL projects – but NIA and IFI can help with this.

B.2.2.3 Reservations

One respondent said that one impact of the LCNF has been DNOs being inundated with new product/service ideas that companies want to trial – they say this is not only through LCNF but Innovate UK and EU FP7. Due to limited resources they say that this has added an additional screening stage for private sector companies wishing to push innovative technology. This opinion was somewhat shared by another respondent that remarked that LCNF has absorbed DNO resources.

Another respondent commented that although it encouraged innovation it also created false hope for SMEs and that it should have been made clearer that there would be a gap between the trials and the implementation of the technology on a large scale.

Finally, a respondent thought that although it has not prevented private sector innovation allowing the DNOs to carry out their own projects with funding it has reduced their dependence on private sector innovation.

B.2.3 Effect of Third Party Access to LCNF Funding (Q2.3)

Questions:
Do you think third party access to LCNF funding would improve the quality of innovation projects and if so why?

B.2.3.1 Summary of Responses

The responses were varied for this question – a fifth of respondents felt it could improve quality, a quarter felt it could possibly improve it and one respondent felt third parties already have access. The rest of those that answered believed access would not improve the quality of innovation projects.

B.2.3.2 DNO Key Role Essential

Six respondents made the point that a DNO would always have to play a key role (in order to be able to trial the technology etc.) due to their role in the network even if a third party was leading the project.

B.2.3.3 Third Parties Have Access

One respondent made the point that it already is accessible to third parties, saying the majority of their NIC/NIA projects are third parties working with them to develop solutions. They go onto say they encourage this, and ensure they publish a lot of material to assist prospective partners in understanding their network challenges and the influence of these on their innovation priorities. The respondent also says they are happy to be the one to contact the DNOs if the project requires network distribution cooperation.

One respondent also mentioned various sources of innovation funding that are funded through tax revenue and are provided as grants. Also mentions Ofgem's electricity network innovation stimulus packages – funded by electricity bill payers and are not structured as grants – the eligibility requirements for the NIA and NIC help networks secure appropriate commercial terms on behalf of the electricity consumers from all parties participating in NIA or NIC funded projects.

B.2.3.4 Third Party Access Would Improve the Quality

Four respondents felt that third party access would definitely improve the quality of the projects. The first gave their reasoning as smart solutions not always being in the DNO's favour.

The second believes it would open up the market and lead to a wider range of projects covering a wider range of challenges. They believe to do this the third party could lead the development with a DNO as a partner to deploy the solution as a trial onto the network – the point of a DNO needing to play a key role was reiterated by several respondents, regardless of their view that it would or would not improve the quality.

The third respondent in the group thought that since the DNOs did not spend all of the money available to them this shows they are short of ideas, and with third party access the whole fund would be utilised. They believe, regarding Electric Avenue, that they took on the role of project lead better than the DNO due to their expertise and various skillsets. Also project partners can be chosen to best meet proposal goals as specialised project teams will be created to utilise the skillsets available, skillsets that would not be held by DNOs.

Finally, the last respondent in the group thought third party access could improve it as DNOs are (rightly) concerned about consistency, safety, etc., they may miss potentially significant improvements simply because the funding has already been carefully approved and there is no appetite or funds for it, whereas third parties may be able to make these improvements. But they also conceded that DNO co-operation would be needed to do any trialling. This response also mentioned that if technology could be developed independent of DNOs (i.e. abroad or at PNDC) it would be more feasible to have a third party lead the project.

B.2.3.5 Third Party Access Would Not Improve the Quality

This view that access would not improve the quality was shared by eight respondents.

Another reason given by a respondent was that having so many invested parties will slow down and complicate the process. Another respondent somewhat seconded this making the point that the number of applications may become excessive.

Another respondent pointed out that there is opportunities for a third party to lead an innovation project at National (Innovate UK etc.) and European (H2020 etc.) level.

A further reason against third party access highlighted by one respondent was the requirement of DNOs to have innovation funding as they do not have access to excess revenues due to regulation and customers cannot be exposed to the risk of an innovation project. One respondent is of the opinion that innovation should be driven by network owners and operators with the interests of consumers at heart, and bring in third party access may take away from that with these parties utilising the fund to benefit themselves more than consumers.

DNO BAU Operations

Two respondents the point that the evaluation criteria for the projects was geared towards the chosen projects being transferable to DNO BAU operations, this required an understanding of DNO business plans, which third parties would not have. It is key that the projects actually relate to challenges the DNO has, and nobody has a better understanding of that than the DNOs.

Other Observations

The point was made by a respondent that it is crucial for DNOs to be able to fund the participation of the third parties required for their expertise as this leads to quality innovative solutions – the collaboration of the DNOs with other industries was emphasised.

B.3 LCNF Scheme Overview

B.3.1 Initial Communication of Information on the LCNF by Ofgem (Q3.1)

> **Questions:**
> How well did Ofgem communicate information regarding the introduction of the LCNF effectively? Were you aware of the LCNF from the outset?
> Was there sufficient information to enable you to understand how you could get involved with the scheme?

B.3.1.1 Summary of Responses

The responses were mixed overall – with more than half of the respondents (11) of the view that the information was communicated well.

Three of the respondents did not answer this question.

B.3.1.2 Awareness of the LCNF

Respondents were made aware of the LCNF through a range of mediums, with some aware of it from the outset and others aware shortly after:

- aware of it through their place in the market;
- aware of it as they owned a DNO business at the start of the process and involved from the outset in the SGF as a supplier;
- aware of it through the workshops Ofgem ran for supply chain on the LCNF;
- aware of it at an early stage; and
- unaware at outset but became apparent soon after.

A further respondent made the point that some elements of the scheme such as the tiered structure and the RIIO cycles could have been made clearer – as not all parties are aware of funding of licensee businesses.

B.3.1.3 How to Get Involved in the Scheme

Around half of those that responded indicated that the information gave them an understanding of how to get involved.

Three respondents found that it was not so clear how to get involved in the scheme, with one of them saying that without the utility approaching them they would not have known how to get involved, and another saying they had to be introduced and encouraged into it by DNOs. Another respondent thought that due to its complexity only parties with prior experience of working together or good connections were in a position to apply for the funding.

One respondent felt there was enough information but that like everyone else they had to learn by experience.

Finally, a respondent suggested that to make it easier for third parties to become involved there should be a forum for information sharing and for partners to express their interest and pitch projects

B.3.1.4 Negative Response

There were two respondents that did not feel the information was communicated well. One of these found communicating with the DNO slow and challenging, with the DNOs being cautious and heavily confidential – so this combined with commercial interests made it difficult to discuss any projects.

B.3.2 Appropriateness of Initial LCNF Criteria (Q3.2)

Questions:
Do you believe the initial LCNF criteria set out by Ofgem was appropriate? Did the criteria give you a clear understanding of the types of projects Ofgem was expecting?

B.3.2.1 Summary of Responses

Of those that were aware of the criteria the general consensus with thirteen respondents in agreement, was that the criteria were appropriate. Only two respondents did not agree with this.

Four respondents did not reply to this question, and one had no clear view.

One respondent felt the criteria gave them a good idea of the projects that would be suitable to propose – and where they could be utilised by the DNOs.

B.3.2.2 Reservations

One respondent felt that the criteria were appropriate to an extent, they are cautious of a regulatory authority having any sort of innovation agenda – they were aware that the projects were not 'approved' but had to meet good practice rules. They do believe that the network owner should be trusted in their knowledge in what the best direction should be for the future of the networks.

Another respondent stated that Ofgem's understanding of IP is too idealised – with their IP clauses requiring participants to give up too much of their IP rights thus creating obstacles regarding soft IP, and making the LCNF less attractive to hard IP.

One respondent, though they agreed with the criteria, felt that Ofgem should have stuck with the original criteria – they did not agree with the reduction in importance of carbon benefits just because they are hard to measure, as this was meant to be a key driver.

Another respondent commented on the debate among DNOs and supply chains regarding the correct projects that would meet customer needs.

Another respondent stated that the initial criteria did not put much focus on the LCNF project outcomes being integrated into BAU, and that this progression was a good one.

Finally, a respondent made a point that it was in the first two years, year one specifically, where the criteria did not constrain the scope much that the two largest projects were funded – with the criteria then becoming more constrained in year 3. They felt that perhaps being that ambitious in year one was a touch naive.

B.3.3 Communication of Information on the LCNF by Ofgem (Q3.3)

Questions:
Did Ofgem communicate information regarding the LCNF effectively?
(e.g. changes to the scheme etc.)

B.3.3.1 Summary of Responses

The responses were mixed, but the general consensus was that the information was communicated effectively, with twelve respondents of this opinion, and four respondents in partial agreement of this. Only one respondent felt the information was not communicated effectively.

Two respondents gave no comment, and one expressed no clear view.

B.3.3.2 Reservations

One respondent felt communication was clear was once you knew the correct place to find the information – but if you did not it was not clear you had to look for it. This point was somewhat seconded by another respondent stating that the ongoing communication from Ofgem was rather infrequent and it was unclear exactly where it existed.

Another respondent felt the issue was the volume of documentation and the complexity of it. One respondent stated that it was not communicated well to their level. Another respondent thought that information was communicated well, with their only issue being the long wait for receiving the SDRC payment, saying that 2 – 3 years is too long for a third party to have to wait.

Finally, one respondent observed there to be a lack of acceptance of change. They knew Ofgem had to ensure money was not being wasted but felt the lack of flexibility and slow responses created both uncertainty and administration for project partners.

B.3.3.3 Mediums

The Ofgem website was mentioned as an effective communication medium by one respondent as was the Ofgem Daily Bulletin by another and another respondent had any important information passed on to them from the associated DNO.

B.3.4 The Application Process (Q3.4)

Questions:
Was the application process straightforward to understand and follow? Was it made clear to you what should be included within your application?

B.3.4.1 Summary of Responses

The majority of the responses were positive – stating that yes the application process was straightforward. Only fourteen respondents answered this question, with one of the remaining two feeling the process was somewhat straightforward, and one feeling it was not at all straightforward.

B.3.4.2 Forms

A few respondents had reservations regarding the forms – with two of the respondents commenting that it required a level of detail that were difficult to know so early in the process.

The respondent that felt the process was not straightforward or clear described the forms as too prescriptive and jargon-filled, meaning a lot of time was needed to even understand what was being asked of you.

B.3.4.3 Suggestions

One respondent felt some process aspects could be leaner, for example the financials that support each project.

B.3.5 Project Selection Process (Q3.5)

Questions:
Was the process for ‘project selection’ clear? Was this clearly communicated?

B.3.5.1 Summary of Responses

The general consensus was that the process was clear, with all respondents agreeing with this apart from two. Six respondents did not answer this question.

B.3.5.2 Reservations

One respondent stated that it was not always clear. They believe that project selection is often made by the DNOs as they have a preferred list of ideas, and the process was set up for the DNO to be the dominant force in selection.

Another respondent commented that it was only clear in retrospect when they reviewed previous submissions.

B.3.5.3 Other Comments

One respondent commented on how the stakeholders' understanding of the process has grown over the years as the process has developed, and is now at a point where they believe the process is sound and results in the selection of the correct projects.

Another respondent commented on how well the process was communicated and that they believed external parties reviewed projects on Ofgem's behalf.

B.3.6 Following of Project Selection Criteria (Q3.6)

Questions:
Did Ofgem follow the 'project selection' criteria as has been outlined? Was there sufficient communication between Ofgem and yourself during the selection process (e.g. did Ofgem ask any clarification questions)?

B.3.6.1 Summary of Responses

The general consensus was that Ofgem did follow the criteria with all of those that had an opinion in agreement of this (ten) – and nine of those ten believing the communication was sufficient. A quarter of the respondents had no clear view for various reasons, (i.e. involved in process, did not lead a project only involved in tier 1) and quarter did not reply.

B.3.6.2 Communication

Several respondents remarked that the communication had been good from Ofgem, and three respondents mentioned that they had been asked clarification questions – with two of the respondents commenting that these questions had been useful to answer, adding value to the scoping of the final project.

One respondent stated that their communication from Ofgem was variable between projects.

Another respondent stated that there were no clarification questions, merely some justification material.

Finally, one respondent said that although communications did not come directly to them, those received through the DNO seemed valid, useful and fair.

B.3.6.3 Other Points

One respondent remarked that the combination of updating governance arrangements, running a transparent process and changing the sources of advice to the panel has led to a strong selection process.

One respondent had no clear view on this question as they thought it would be better suited targeted to the DNO.

B.3.7 Feedback for Rejected Projects (Q3.7)

> **Questions:**
> In cases where a project was rejected, how would you rate the quality of the feedback provided by Ofgem on the reason for its decision?

B.3.7.1 Summary of Responses

Not every respondent answered this question (assuming as it was not applicable to all of them) and the majority that did answer said that it was not applicable to them.

Of those that did answer – four of the five felt that the feedback received was sufficient, with the remaining one regarding it as partially sufficient.

B.3.7.2 Reservations

One respondent remarked that in general the feedback was consistent with the questions asked throughout the evaluation process but occasionally some of the reasoning felt subjective since it was more based upon perception than fact.

B.3.8 Perception of Ofgem's View on Innovation (Q3.8)

> **Questions:**
> How has the LCNF altered your perception of how innovation is viewed by Ofgem?

B.3.8.1 Summary of Responses

Two thirds of the respondents that answered the question felt the LCNF has definitely changed their perception with them now of the opinion that Ofgem does value innovation.

Four respondents did not share this opinion.

A quarter of respondents either not respond to this question, or did not have a clear opinion, with one of them feeling it was too soon to tell.

B.3.8.2 Positive Responses

One respondent commented on the amount of opportunity it has created for SMEs.

Another respondent remarked that the LCNF has been a catalyst to change within the DNOs.

One respondent believes the LCNF is behind some of the most innovative and far reaching projects in the UK.

Finally, one respondent mentioned that they think the work done as a result of the LCNF has highlighted the power of storage technology to OFGEM.

B.3.8.3 Reservations and Suggestions

One respondent feels that at times it feels like Ofgem's main concern is just awarding the projects as opposed to monitoring them to ensure they fulfil their potential.

Two other respondents felt there is still a way to go regarding creating an environment where innovation is welcomed. This view was somewhat shared by one respondent that made the point that Ofgem's commitment to other issues such as developing innovation cultures, organisational commitment, sector innovation capabilities, and good practice and excellence in innovation project would be valuable.

Another respondent suggested a funding category for new entrants/partners with small projects could be beneficial, as otherwise there is a tendency for the budget to get used on large projects.

B.4 Specific project partner questions

B.4.1 How Project Partners Became Involved (Q4.1)

Questions:
How did you become involved in an LCNF project? Were the DNOs proactive or reactive in their engagement with you?

B.4.1.1 Summary of Responses

The vast majority of the respondents (fourteen of nineteen responses) became involved in an LCNF project as a result of the DNO approaching them i.e. the DNO was proactive. There were three respondents that felt they were proactive and made contact with the DNO, and another two already had connections with Ofgem/experience with the LCNF.

The four respondents that were not approached by the DNO classified the DNOs as proactive aside from that, or becoming more proactive as the LCNF fund has gone on – with one of these mentioning the DNOs using the ENA portal to increase awareness and engage in Requests for Information. Another respondent felt the DNO's were reactive with respect to their proposed projects, but they were approached by the DNO regarding the I2EV project.

A point was made by one respondent that more recently the openness of the some DNOs is somewhat tainted with a slightly more guarded and cautious approach. They state this could be as a result of various issues such as; IP, increased competition, projects not delivering, greater commercial value of innovation outcomes given the stronger incentives in RIIO-ED, having a better idea of the innovation that aligns to their delivery strategies. They believe the considerations make sense and are required, but it needs to be ensured they do not become a hindrance to innovation.

B.4.2 Contributed Initially (Q4.2)

Questions:
How did you contribute to the initial project innovation ideas and scoping?

B.4.2.1 Summary of Responses

All of the respondents felt that they were involved in and contributed to the initial project innovation ideas and scoping phase of the project(s), with many mentioning them working in collaboration with the DNOs.

One respondent contributed to brainstorming sessions, screening proposals and submissions/panels. Another respondent was in involved from the ISP stage, working alongside the DNO from that point.

Finally, one respondent provided an example of having differing viewpoints to the DNO they were working with – this was regarding SMETs meter availability and was down to another project partner being overly optimistic, resulting in the expectation for the rollout of the meters being too high.

B.4.3 Contributing to Success (Q4.3)

Questions:
How did you contribute to the success of the project, how were ideas developed and incorporated during the project?

B.4.3.1 Summary of Responses

None of the respondents felt they did not contribute, across the respondents there were various degrees and examples of their contribution.

B.4.3.2 Contribution

Two respondents felt involved at all stages of the trial – with their ideas and comments implemented from development to conclusion. Another respondent had a similar view to this stating that they were instrumental to bid development, the testing of core ideas and the overall design and approach.

Modelling and Analysis

Three respondents contributed when it came to modelling and analysis aspects of the trials.

Customer Aspects

A customer-related contribution was mentioned by two respondents. The first developed proposals for improvements mainly regarding the increase of customer take-up of projects, and the second encouraged NPG to consider how savings to the customer could be realised.

Review

A reviewing role was taken on by three respondents. The first two respondents reviewed the submission, with one respondent also taking on an authoring role. The final respondent stated that if a project partner has had previous experience they may be asked to review the overall bid document.

Ideas

Three respondents mentioned that their own ideas were implemented into the project. With three other respondents stating that ideas were developed through discussions with the DNO, be it at the start or throughout.

Other Contributions

One respondent stated that they worked on developing of the business model, with another respondent saying that they provided a number of resources throughout the project.

Another respondent's contribution was the building, testing and delivering of ANM systems and supporting tools, knowledge and capabilities. They also mentioned that they contributed ideas for roll- out, scale up and business adoption to exploit the outcomes of projects – they believe these topics must be of focus for the success of the innovation programme.

B.4.3.3 During the Project

A quarter of the respondents spoke positively about their collaboration and regular communication with the DNOs.

One of these respondents mentioned that they had weekly meetings with the DNO, during which they reviewed data and results, and adapted the plan as required. Another of them mentioned the round table discussions they had with the DNO and often with other project partners, as well as meetings with project partners without the DNO. Working closely with project partners was mentioned by another respondent. Another of these respondents felt that the DNO having a senior dedicated engineer capable of giving day to day input into the PM helped ensure success (they were PM for their projects).

One respondent have been involved in several projects thus have experienced various different governance styles. They say although in general they have had good experiences, they believe that a review of innovation project execution could be a good idea in order to establish good practice in this area. This respondent also said they believe being flexible to change was important for success

B.4.4 Contributed to Roll Out (Q4.4)

Questions:
How did you contribute to the project roll out?

B.4.4.1 Summary of Responses

For three of the respondents, their projects were not yet at the final roll-out stage so they could not comment. For the other respondents that answered the question, apart from one, they all had a reasonable contribution to the project roll out. Only one respondent stated that they generally are not as involved in the project roll out phase after completion of the LCNF project.

Project Management

Three respondents stated that they had a project management role or led the project roll-out.

Dissemination

Two respondents said they have supported dissemination.

Demand-Side Response

Two respondents stated that they operated DSR trials; the trials of one respondent for domestic and I&C customers.

Supplied Product

Two of the respondents supplied products, one in the form of a large quantity of smart maters.

Research and Development

Two respondents had a role that included research and development.

Other Contributions

One respondent was engaged in meetings and setting test runs and trials, as well as data analysis. Another respondent was also involved in trials, preparing the methodologies, as well as providing expertise to other project partners in order to accelerate their project progress.

One respondent contributed to developing commissioning documents and had a part in the commission process

Suggestion

One respondent made the suggestion that DNOs should consider continuity of expertise in the wider rollout of LCNF learning outcomes.

B.4.5 Engagement Mechanisms (Q4.5)

Questions:
What general comments do you have about the engagement mechanisms used by the DNOs in respect of initiation, your inclusion and involvement and development of ideas throughout the project lifespan?

B.4.5.1 Summary of Responses

In general the responses were very positive – with the majority, thirteen of the seventeen that replied, of the respondents classing their engagement with the DNOs as a positive experience.

Two respondents did not respond to this question.

B.4.5.2 Positive Response

One respondent mentioned the high motivation of DNO staff, with another respondent finding the DNO communicative and engaged, saying they helped develop and adapt ideas throughout. Other respondents had similar positive views to these – with comments made such as clear communication channels, professional and robust engagement, and effective project collaboration. Another respondent stated that they maintained a close relationship with both the DNO and the other project partners during the delivery phase, both on an ad hoc basis and regularly scheduled project partner meetings.

B.4.5.3 Negative Responses

One respondent found that the combination of the different working cultures and motivation of the project partners could at times lead to licensees marginalising the other partners.

Another respondent thought that there was a tendency for the engagement to be biased towards personal relationships, meaning you often saw the same project partners with the same DNO year after year.

B.4.5.4 Suggestions

One respondent felt that DNOs proactively encouraging third party innovation ideas, as National Power used to, would be beneficial.

Finally, one respondent suggested that discussing and establishing good practice with regards to innovation programme management could be a valuable initiative.

B.4.6 Commercial Arrangements (Q4.6)

Questions:
How well did the LCNF allow satisfactory commercial arrangements?

B.4.6.1 Summary of Responses

Over half of the respondents (twelve) believed the LCNF allowed for satisfactory commercial arrangements, with several saying they had no concerns.

Two respondents did not answer this question.

B.4.6.2 Other Points

One respondent remarked that some costs were met by them, and for the remaining costs WPD issued them with a PO.

B.4.6.3 Reservations & Suggestions

One respondent felt that it would be beneficial for various elements to make up contribution, as they mainly provide people meaning their only real recourse to contribute is through reduced day rates. On one of their projects the DNO did aim to involve the right partner activities within contract and this worked well in their opinion.

Another respondent stated that DNOs are naïve regarding what offers will entice customers, and believe they need to take note of (in their case) DSR aggregators' experience in designing proposals for customers.

One respondent, though they believed the arrangements were satisfactory thought there should be more flexibility regarding change considering the innovative nature of the projects.

Another respondent felt it was positive that the LCNF allowed new commercial arrangements to be developed; though the implementation of these new arrangements had the potential to be frustrating and time consuming.

Payment milestones were pointed out by one respondent as being too long, saying that this was offset by the provision of an up to 3-4 year pipeline of work.

Regulatory Framework and Governance

The regulatory framework and governance were mentioned by two respondents. One of these thought that the arrangements were hampered by the overarching regulatory framework, continuing on to say that they were at times concerned the funding would be clawed back as a result of retrospective judgement. The other respondent remarked that as a result of Ofgem governance many of the DNOs would not implement default arrangements around IP and risk management, as needed for innovation projects. They continued on to say that the risk on delivering the project seemed to be more placed on the supplier than the DNO, as within the DNO the procurement team was running the project meaning their commercial terms aligned with a BAU perspective – which was not always compatible.

B.4.7 Intellectual Property (Q4.7)

> **Questions:**
> To what extent are Intellectual Property (IP) rights treated appropriately within the LCNF and have any concerns been addressed in the latest NIC IP arrangements?

B.4.7.1 LCNF

Summary of Responses

Just less than half of those that responded (eight) found that IP rights were treated appropriately within the LCNF; the remaining respondents had varying degrees of issue with them, and three respondents did not answer this question.

Sharing of IP and Giving Up IP Rights

A quarter of the respondents had issue with the required sharing of intellectual property. One respondent found the clauses restrictive, especially the sharing of intellectual property among all of the DNOs – saying this is essentially publication of results. Another respondent made the point that the degree of sharing of IP required boundaries to be pushed.

As one respondent communicated in another section of the questionnaire, they believe the standard clauses requires participants to give up too much with respect to IP rights – creating obstacles for soft IP and making it unappealing for hard IP. Another respondent noted that the value of IP for third parties needs to be taken into account, though is aware that this will require a lengthy process and paperwork. They also mentioned that a fair balance must be found between the research funder (foreground IP) and the background existing IP.

Finally, one respondent made the point that as an SME they are cautious not to give away their core capability in case the key ideas from it might get used as 'new learning' on a project, continuing onto say that they are careful about what exactly they say in that respect.

Other Issues & Suggestions

One respondent believed more guidance from Ofgem would have been beneficial – possibly an IP framework.

Another respondent thought the IP terms have been an issue in terms of registration of IP, ownership, access, exploitation (commercially and otherwise), inventor rights, publication rights, etc. They and one other respondent found the terms potentially restrictive to the most appropriate exploitation of different types of IP. The respondent suggested an open debate on IP arrangements – believing that would produce the most appropriate IP arrangements to serve the UK customer base in years to come after the project has concluded.

B.4.7.2 NIC IP Arrangements

Summary of Responses

Not many respondents mentioned the NIC arrangements. Two respondents were not aware of the NIC arrangements thus cannot comment.

One respondent had the same view on the latest NIC arrangements as the LCNF ones – that they are restrictive.

B.5 Additional Comments

B.5.1 Additional Comments (Q5.1)

> **Questions:**
> Please make any additional comments in respect of the LCNF success or otherwise here.

B.5.1.1 Responses

There were not many additional comments, but of the comments made the majority were positive.

One respondent gave credit to the ENA for the LCNF/LCNI Annual Conference which they found to be very useful, but thought the lack of attendance of Ofgem's LCNF panel members gave a poor impression. They believe one reason behind the success is allowing the network companies to make the decisions and manage projects, and supporting them in doing this, leading to the companies having a strong sense of ownership of the projects. They think it is important that senior management is involved, and is without major financial return, as in the future it may be necessary to demand innovation without incentive.

Another respondent felt that the evaluation was welcome and essential for the ongoing success of network innovation and for the public good.

A further respondent believed the LCNF has been essential in changing the DNO outlook on investing in low carbon solutions, but that the NIC may struggle to keep the interest of the networks and the supply chain. They feel that NIA will become more appealing due its benefits and the process being more tangible – and thus less risky than participating in NIC bids. They continued on to say they look forward to working with Ofgem and wider industry stakeholders in the future to ensure effectiveness of the innovation process.

Another respondent stated that for a small company like themselves the LCNF has provided great opportunities, and allowed them to build in confidence. But they also hear of DNOs (or PMs) being less open to involving SMEs, which they feel is short-sighted as SMEs with unique and smart ideas are exactly those who would benefit from the support.

Finally, one respondent believes the LCNF has definitely been positive from a culture change and technical point of view, but it is harder to judge if it has been so positive in a value for money sense. They continued on to say that as projects move down the TRL it will become more risky – and they query if there will be a point where it no longer makes sense that Ofgem has control of the scheme.

B.6 Research Establishment Questions

B.6.1 *Increased Engagement with DNOs (Q6.1)*

Questions:
Has the LCNF increased your engagement with DNOs? Please provide examples where you can

B.6.1.1 Summary of Responses

All bar one of the respondents that answered the question (six of seven) stated that the fund did increase their engagement with DNOs – with the one negative response down to them already having a reasonably established relationship with nearly all the DNOs through previous work.

One respondent now has a supportive DNO aiding them with an ESPCR research project and involvement with one DNO led to further work with another DNO in a similar area.

Another respondent now has more awareness of the activities and concerns of DNOs and thus more awareness of the opportunities for universities to engage with DNOs. Another respondent agreed with this point.

Finally, one respondent remarked that although they had a lot of interaction with the DNO during the project unfortunately many of that team have been promoted out of the future networks sector so the long term relationship may not be as good it could have been.

B.6.2 *Fitting Into Existing GB Framework (Q6.2)*

Questions:
Do you think the LCNF fits appropriately into the existing GB research framework?

B.6.2.1 Summary of Responses

Half of the respondents (four) felt the LCNF does fit into the existing GB research framework.

B.6.2.2 Technology Readiness Level

One respondent suggested the LCNF/NIC could adopt various levels (early/mid/late) for funding requests – allowing funding for early stage ideas i.e. lower TRL, and bigger funding percentages for ideas at a higher TRL.

Another respondent noted that the high TRL of LCNF projects can pose a challenge for universities trying to contribute, as it is different to their usual focus of low TRL research. Though they also mentioned that the fund provided the opportunity for universities to interact with the innovation teams of licensees can produce new research questions and lead to future lower TRL projects.

One respondent also discussed the focus of the LCNF on high TRL projects, comparing it with research councils that tend to focus on lower TRL technology. They believe it is this that makes the LCNF fit perfectly into the GB research framework.

Finally, one respondent believes the country needs mechanisms to get from low TRL to a TRL level suitable for Tier 1 and Tier 2 projects. They noted that network trials are required to reduce risks and justify investment to raise the TRL, and for this to work both support and justification for DNOs to be involved is required.

B.6.2.3 Other Points

One respondent felt there should be more awareness of current programmes underway with ETI, ESC etc. to ensure the same activities are not being carried out, suggesting this could be achieved by a coordination forum if there is not one already.

Another respondent felt that it fits in because other funding sources are not as well suited to funding projects that involve working with the actual network. They went on to say they are not aware of any LCNF projects carrying on from previous projects funded by other sources, saying they are only reliant on these other projects to maintain the innovative environment required for the LCNF to flourish.

One respondent felt the application and review processes and outputs of the LCNF remain outside the RCUK framework. They say the projects are focused on technical and engineering aspects as opposed to the social science components which they say are required for the systematic changes required, elaborating on this point to say not a lot of working relating to the ESRC or the AHRC is done.

Finally, one respondent compared the funding to InnovateUK and other sources, which they say encourages innovation that gives a competitive advantage thus only participating specific companies not the whole industry.

B.6.3 Fitting into Horizon 2020 European Research Programmes (Q6.3)

Questions:
What is your opinion of how the NIA (previously IFI) and the NIC (previously LCNF) fits with the Horizon 2020 European research programmes?

B.6.3.1 Summary of Responses

Three of the respondents that replied stated outright that they felt the fit is appropriate. Other respondents had no clear view on the fit but expressed opinions on the research programmes.

One respondent mentioned that though the LCNF and H2020 programmes have similar objectives, the LCNF is of course more UK specific and closer to the market than H2020. Another respondent pointed out that UK issues are different to those in Europe due to our island location and energy landscape, thus the UK fund is needed, they believe trying to get the same funding from H2020 would result in issues around partners with the same goals and obtaining matched funding.

The risk of duplication was mentioned by one respondent, they feel as innovation is so new to GB it is possible that duplication may happen across the two funds, but the fact that H2020 is more focussed on the future decreases this risk.

The same respondent expected that more engagement would occur with the H2020 fund and its projects, for example presenting at the LCNI conference.

Another respondent felt that the LCNF is much easier than the H2020 to apply for and better for encouraging innovation. They feel H2020's numerous requirements on partnering and international collaboration are a barrier to innovation.

Finally, one respondent though they did not comment on the NIA and NIC fitting in with the H2020 programme, expressed their opinion on the NIA, previously the IFI. They felt that the IFI was good, and believes that the IP rules of the NIA are less favourable to the partner – leading to more established ideas presented initially but also these ideas will err on the side on the caution. They went on to highlight the importance of reducing lawyer involvement and legal constrictions at this level of TRL, as it can reduce the creativity.

B.6.4 Gaps in Present UK and EU Funding (Q6.4)

Questions:
Aside from the above are there any other gaps or problems that you perceive in the present research funding arrangements in GB and Europe which are a barrier to successful innovation?

B.6.4.1 Summary of Responses

The responses to this section were very mixed with many gaps and suggestions highlighted by the respondents. Only one respondent stated they saw no gaps in the current funding arrangements, and another felt it was too early to say.

One respondent had the view that the complexity and time consuming nature of funding applications makes it a challenge for smaller companies or research groups to get funding, in comparison to large companies that have dedicated teams for these activities.

Another respondent felt that though network innovation is well funded, the inability to propose projects is a barrier. This respondent also believes that DNOs should have to outsource more of the cost and ensure the analysis is of a consistently high quality.

One respondent was of the opinion that it would be easier to consider economic aspects of concepts being considered if there was more information on the future market, such as possible scenarios/frameworks.

The same respondent also made the suggestion that some of the funding given to project partners be set aside for them to have young staff or students working on the projects – this introduces those just coming into the industry to innovation, as well as teaching them about it; it is an investment for the future. This could also, to a degree, relieve the staffing issues for innovation projects.

Another respondent believed that more focus should be put on cross-industry collaboration – providing electric transport as an example of where collaboration between the energy and transport sectors will be vital for success.

The problems of research type external funding were pointed out by a respondent – too time consuming to set up, project approval sometimes requires to be approved prior to the start and you have to share ideas and possibly lose control. They went on to say there are small pots of Government funding for some things (export, manufacturing, and training for example) that are much easier to access.

Finally, one respondent felt that engineering research only focuses on the technical considerations of the energy transition, but not the institutional, regulatory, investment, political or social dimensions – adding on that work on customer energy practices is again separate. They highlight UKERC as a place that does try to work on all of the aspects together, but say it has not had a significant role in LCNF projects.

B.6.5 International Innovation Funding Mechanisms (Q6.5)

Questions:
Are you aware of any international innovation funding mechanisms that should be considered in our evaluation?

B.6.5.1 Summary of Responses

All but one of the respondents were not aware of any other international innovation funding mechanisms that should be considered in the evaluation, with one respondent commenting that the LCNF is/was uniquely generous.

This one respondent suggested looking at the funding provided for smart grids and energy systems in Singapore by the Energy Markets Authority – the equivalent of Ofgem there.

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ANNEX C – RESPONSES OF INDUSTRY MEMBERS

C.1 Success of the LCNF

C.1.1 LCNF Meeting its Objectives Regarding Innovation as Business as usual (Q1.1)

Questions:
Do you believe that the LCNF has met its objective in incentivising the DNOs to include innovation as part of their core business?
What justification do you have for your response?

C.1.1.1 Summary of Responses

Over half of the respondents (eleven) felt that the LCNF has met this objective. Though several were of the view that although the fund has incentivised DNOs to be more innovative, innovation was yet a part of core business and there was a long way to go before that part of the objective is met.

C.1.1.2 Core Business

Reservations

Four respondents did not think that DNOs saw innovation as part of their core business.

One of these respondents one went on to say they thought that without the funding, any innovation within the DNOs would dry up. Another of the respondents went onto say the only example of DNOs using an innovative solution as business as usual is Demand Side Management. Another respondent in the group believed that although the culture has improved the reward does not outweigh the considerable management time DNOs would have to invest to bring projects forward to the next stage. Finally, one of the respondents believes that more needs to be done to incentivise the DNOs, not just NIA funding. There was also concern about the role that the EIC plays in brokering innovation ideas between the DNOs and project partners

Positive Responses

About a third of respondents commended the DNOs on their improvement with regard to bringing innovation to the core of their business, with many commenting on the dedicated innovation teams DNOs have. One of these respondents believes that more recently DNOs have been able to identify issues and develop projects that solve them. The response continues on to say the culture change in DNOs is apparent – with many now having dedicating innovation departments with senior directors attending panel meetings, and in panel meeting being able to justify their need for projects and how to integrate it into their business.

Another respondent feels that the proof in this objective being met is the increased interest of senior management in successive rounds.

C.1.1.3 Other Points

One respondent thought that the fund has changed the core business of DNOs but only to include high TRL innovation with low TRL innovation being overlooked as it will not provide any benefit in the regulatory period.

Another respondent believed it was important to mention that the work carried out under the IFI contributed to the success of the LCNF, the past learning and development was valuable for the LCNF.

Finally, two respondents highlighted that innovation is still driven by funding under RIIO (NIC and NIA).

RIIO-ED1 was mentioned by a further respondent – stating that as a result of the LCNF DNOs could accept lower Totex allowances in RIIO-ED1 that incorporated some efficiencies, and therefore represent good value in the period 2015-2023, and thus a medium-term return on investment made by customers in 2010-2015.

C.1.2 LCNF Meeting its Objectives Regarding Low Carbon (Q1.2)

Questions:
Do you believe that the LCNF has met its objective of helping the DNOs move towards a low carbon business whilst maintaining security of supply and delivering value for money to customers? What justification do you have for your response?

C.1.2.1 Summary of Responses

The responses to this part of the questionnaire were mixed – with some respondents believing the objective was met, some believing it was not and others believing the objective was only partially met.

One respondent did not answer this question.

C.1.2.2 Positive Responses

Seven respondents felt that the objective was met.

One respondent in this group noted that the DNOs have connected large quantities of distributed and renewable generation, while also achieving good performance regarding CI and CML targets.

Two respondents felt the LCNF focussed on projects that aided a low carbon future. One of these respondents continued on to say, as a panel member, they have always taken value for money and security of supply into account and can't think of any instance where security of supply was threatened.

The other respondent in this group went on to say that DNOs have committed to investment savings that during RIIO ED1 alone easily exceed the total consumer contributions to the LCN Fund. They also commented on the quality of supply performance – saying that it continues to improve, though this is also partly due to non LCNF funded innovation. This respondent believes the competitive nature of Tier 2 ensured that submitted projects were well thought out with clear business cases, also driven by the DNOs wanting to have a strong reputation from being a frequent winner of bids.

Finally, a respondent from the group felt commitment to the objective was proven in C2C having to formally apply for P2/6 derogations.

C.1.2.3 Reservations

Three respondents made the point that it is too early to tell if this objective has been met as many projects have been completed but are yet to transition to “business as usual”, labelling innovation as a longer term initiative.

One respondent believed that though some projects have met this objective, some were rejected as they did not meet the narrow criteria.

Another respondent believes that since the DNO’s have carried out a wide range of projects with no overall vision they are not able to provide a credible selection of low carbon solutions.

A point was made by one respondent that the role of the DNO is to facilitate the transition and find the cheapest ways to connect low carbon technologies, as well as reducing emissions directing which is hard to do since their business is only responsible for few emissions.

A further respondent remarked that the expected DNO capacity growth as a result of a low carbon economy has not happened, believing this is down to limited and fluctuating policy support.

Finally, a respondent highlighted their concern regarding the difficulty SMEs have trying to enter the utility market, as there is a tendency towards anticompetitive bias and an emotional aversion to change on the GDNs part. They think buying-in is a slow process as the GDNs and their supply chain are required to be won over.

C.1.2.4 Project Examples

Three of the respondents mentioned the connecting of distributed generation as an example of low carbon innovation utilised by DNOs, as this allowed more renewable sources to be connected to the grid. Other projects and technology mentioned were; dynamic reconfiguration of networks to meet demand and restore outages, demand response techniques, Active Network Management, Capacity to Customers, Solent Achieving Value from Efficiency and Flexible Urban Network – low voltage.

One respondent made the point that within the gas sector they have seen several innovations that significantly reduce excavation, maintain supplies and thus offer value for money to the customer.

C.1.3 LCNF Meeting its Objectives Regarding Low Carbon and Energy Saving Initiatives (Q1.3)

Questions:
Do you believe that the LCNF has met its objective of helping the DNOs facilitate low carbon and energy saving initiatives? What justification do you have for your response?

C.1.3.1 Summary of Responses

Many respondents had a similar response to this question as they did to question 1.2. Only one of the respondents thought that the LCNF had 100% not had an impact in this area – there was a mix of responses saying it definitely had or partially had met the objective.

Two respondents did not answer this question.

C.1.3.2 Energy Saving

Three participants felt that there was more of a focus on low carbon than energy saving technology. One of these respondents felt there was only so much distribution companies could do with regard to energy saving other than improve efficiency and reducing losses, which explains the smaller number of projects on this. Another respondent agreed with this, commenting that they had not seen a lot of energy efficiency work carried out by DNOs – with a greater focus being on demand response.

One respondent felt that with regards to energy saving initiatives it is suppliers that have taken the lead, not the DNOs. Another respondent said that although the LCNF has encouraged the uptake of energy efficiency measures, they have not seen any results of it.

C.1.3.3 Other Points

One respondent thought that although good work has been done in this area, not enough projects have been transferred to business as usual. The respondent felt this was down to the network being made up of long-life assets and possessing a “fit-and-forget” design philosophy. Another respondent felt that many projects focused on driving the existing assets harder since it has been proven that absolute limits are not being pushed.

A further respondent felt that the DNOs running the projects was an issue as they do not necessarily take into account the end consumers point of view. This respondent also felt that DNOs should involve third parties at an earlier stage of the bid i.e. communities and local authorities.

C.1.4 LCNF Meeting its Objective Regarding the Dissemination Of Learning To Facilitate Roll-Out Of Successful Trials (Q1.4)

Questions:
Do you believe that the LCNF has met its objective of the dissemination of learning to facilitate roll-out of successful trials? Are you able to provide examples to support your view?
Are you aware of learning being implemented from trials by other DNOs as well as their own? Are you able to provide examples to support your views?

C.1.4.1 Summary of Responses

The overwhelming consensus was that the dissemination aspect of the LCNF is strong, and this objective was met, with ten of the fifteen respondents that answered this question giving an outright yes.

One respondent felt in their case that the EIC had blocked this objective.

With regard to DNOs implementing learning from trials that are not their own, the responses were mixed, with some respondents aware of this occurring and four of the respondents that answered that part, not aware of any examples of this.

C.1.4.2 Successful Dissemination

LCNF Conference

A quarter of respondents mentioned the LCNF/LCNI conference as a really useful tool for dissemination with one respondent saying it is one of the major EU events in this field. One other respondent commented that at the most recent conference there was not enough examples of large scale business as usual implementation of projects, carrying on to say they hope this changes as RIIO continues.

Other Dissemination

Other examples of dissemination mentioned were; individual DNO events, DNO innovation websites, ENA Smarter Networks Portal, project-specific events, information in professional journals and regular published project reports.

C.1.4.3 Hesitance to Share

One respondent felt that due to the regulator creating competition between DNOs, it seems unrealistic that they will be prepared to share intellectual property with other DNOs – thus thinks the DNOs try to strike a balance between meeting obligations and protecting their own IP. They do not think this can be avoided without getting rid of comparative regulation. Another respondent somewhat agreed with this – saying they found that DNOs can sometimes be hesitant to share lessons learnt from project.

Another respondent pointed out that some DNOs actually searched internationally for good practice of learning dissemination, and have used this to change their culture. This respondent also found that at times academics have been hesitant to share due to their vested interests, sharing the detail of data as an example.

C.1.4.4 Learning from Trials Implemented by Other DNOs

As mentioned, a quarter of respondents were unaware of any examples of this happening.

Other respondents were aware of this occurring and provided various examples, as detailed in the following paragraphs.

One respondent stated that there is a lot of evidence provided by DNOs to show they are building on the information gathered by other companies. With another respondent noting that successive submissions utilise the learning from previous trials.

The Good Practice Guide for the ANM was mentioned by one respondent as a good example of DNOs working collaboratively, in order to create a guide for the technology to be utilised in the future. They gave another example of DNOs working collaboratively; the 'Management of Plug-in Vehicle Uptake on Distribution Networks' project – the objective being to agree an approach to managing plug-in vehicles on the network. They conclude with the point that approaches to DNOs collaborating are continually in development to ensure they are using the best approach to allow knowledge transfer and consolidation. Collaboration was mentioned by another respondent – mentioning proposals they are aware of that are supported by more than one DNO. They also remarked on Ofgem's collaboration requirements when assessing projects pre-funding and mentioned that "automatic" sharing occurs between DNOs in the same ownership group.

Some respondents mentioned the trials that are building on the work of previous trials. For example; National Grid's Transmission & Distribution Interface 2016 project screening bid which builds on UK Power Networks KASM LCNF Tier 2 project, WPD approaching UKPN for a specification for a phase-shifting transformer following their successful deployment of that device as part of their Flexible Plug & Play Networks project, South Wales network logging, Orkney DSM trials.

Another respondent knew that the lessons learnt from their NIA funded project have been adopted by two other DNOs. They believe when a DNO is adopting a new technology, due to their risk adverse culture it is important that they feel supported, and see that other DNOs have confidence in the technology.

A further respondent has been approached by other DNOs for equipment intending to use it for the same function as other DNOs have; which they have deduced is due to knowledge dissemination.

Finally, one respondent say they have delivered many projects through IFI, NIA and NIC funding that have been fully adopted by the sponsor GDN, this has been accompanied by the sharing of learning. They carry on it say it is a slow process, often requiring the supplier to push it, as opposed to the network.

C.1.5 LCNF Meeting its Objective Regarding Effective Collaboration Between DNOs and Project Partners (Q1.5)

Questions:
Do you believe that the LCNF has met its objective of effective collaboration between the DNOs and project partners? Where appropriate please provide evidence of the success, or otherwise, of collaboration

C.1.5.1 Summary of Responses

The general consensus as agreed on by nine respondents was that the LCNF has met this objective, with many respondents speaking positively regarding the collaboration that has occurred. One respondent stated that there has been a marked increase in partnering since IFI.

C.1.5.2 Project Partners Involved

Two respondents mentioned the diverse range of project partners there has been – academics, consultants, SMEs, technology suppliers – with the latter adding that this has expanded project scopes beyond technical matters.

Small Medium Enterprises

Three of the respondents, mentioned the point that SMEs are less likely to be involved in the LCNF than larger companies.

Two of these respondents made the point that DNOs are more likely to work with universities and major suppliers than companies such as SMEs and start-ups. The latter said this behaviour was justified due to DNOs being under such pressure DNOs are under to deliver by both Ofgem and their shareholders; and with them having responsibility for Critical National Infrastructure they need to have the utmost confidence in their partners. The former believes the suppliers could also have pushed harder to get involved, but has heard feedback that the network operators are not keen for their networks to be used to test new developments – especially those that are out with the comfort zone of the industry.

Another of the respondents felt this was due to the large risk a company has to take on being part of a project and this risk being not proportional to the company size, meaning it favours large companies. They feel if this risk was eased, many more SMEs could get involved and it would benefit the UK market.

C.1.5.3 Other Points

One respondent remarked that some DNOs now actively invite proposals through their websites or issue calls for expression for interest. Whereas another respondent believes DNOs are generally the initiator when it comes to project proposals.

The same respondent thinks stakeholder collaboration is essential for a successful roll-out of innovative technology.

One respondent believes those projects that involved project partners, National Grid and other DNOs at an early stage definitely benefited from it.

Finally, one respondent noted that there is evidence of project partner – DNO collaboration but less so of DNO – DNO collaboration though they do learn from other trials.

C.1.5.4 Barriers

Another respondent is aware of some larger companies being hesitant to participate in later years due to the degree of IP sharing required meaning they could not retain IP where they expected.

One respondent made the point that potential project partners do not want to collaborate with DNOs on developing a project idea as they then need to tender for it; they think DNOs prefer to develop the idea themselves then tender for equipment, which reduces collaboration.

Another respondent believed that DNOs need to be penalised if they do not have good time management, in eight projects they were involved in only two were delivered on time, and for the ones carrying on longer than intended the project partner must ensure they have staff available for the duration of the project for smooth delivery.

One respondent mentions that there may be problems with commercial projects as a result of confidentiality issues.

The view of one respondent was that the follow-on collaboration projects they had planned were rejected due to direct interference by the EIC.

Finally, one respondent believes that given the uncertain return on projects, the collaboration is more limited than would be expected considering the money on offer.

C.1.6 Barriers that Affected the Outcome of the Project (Q1.6)

Questions:
Are you aware of any barriers that may have affected the outcome of the projects?

C.1.6.1 Summary of Responses

Only two of the respondents knew of no barriers that may have affected project outcomes. The others provided a range of different barriers, with not one standing out as the main barrier.

Two respondents had no clear view, and one did not respond.

C.1.6.2 Intellectual Property

Two respondents cited IP as a barrier, with the latter stating IP ownership discouraged companies from engaging with GDNs. The former felt that IP Ownership should not default to the DNO, instead at the kick-off of projects the party that will hold and utilise the IP should be identified.

C.1.6.3 DNO Related

One respondent felt the lack of resources DNOs had available for innovation projects was a barrier, as the requirement to balance day-to-day work with innovation leads to work being delayed.

Another respondent listed various DNO related barriers; DNOs are primarily technical companies that are more comfortable working within areas of which they are knowledgeable, DNOs don't always seek best practice examples; new skills were required to be developed in order to work with non-technical partners; DNOs aren't guaranteed to have the project management available to lead the projects.

C.1.6.4 Ofgem Related

Ofgem restrictions were identified as a barrier by two respondents. With one respondent pointing out that their lack of flexibility regarding delivering project goals led to increased risk, and the other respondent feeling that their restrictions on the nature of projects was a barrier to innovation i.e. lack of commercial development of CLASS.

The pressure put on DNOs was mentioned by two respondents. The former believed the pressure on DNOs to succeed led to less adventurous ideas going forward, as no projects are allowed to fail. The latter mentioned the pressure to demonstrate value for money in LCNF projects – feeling this led to less collaboration and more of a buy-sell relationship since costs had to be finalised pre-submission.

C.1.6.5 Other Barriers

One respondent thought one key barrier is the conservative nature of the industry – security of supply is the highest priority – so new and untested approaches are treated with caution.

Another respondent felt the main barriers were EIC related – the ability of their project engineers, their political and commercial goals, and the EIC's influence over the DNOs and GDNs i.e. the need to check decisions with EIC.

Other barriers mentioned by a respondent were technical problems (e.g. components such as large batteries) and struggling with customer recruitment.

Finally, one respondent cited what they thought of as the usual barriers of cost and consumer resistance.

C.1.7 Barriers That May Have Discouraged Project Partner Involvement (Q1.7)

Questions:
Are you aware of any barriers that may have discouraged project partner involvement?

C.1.7.1 Summary of Responses

Four respondents that answered the question felt there were no direct barriers. The barrier most respondents mentioned was the intellectual property rights with this being mentioned in six responses.

One respondent had no clear view, and one did not respond.

C.1.7.2 Intellectual Property

As mentioned, intellectual property was mentioned as a barrier by several respondents with the issue being the partners having to give up too much ownership of IP. One of these respondents stated that although background IP is protected and foreground IP is to be shared; sometimes it is not possible to reveal the latter without revealing some of the former. They believe allowing partners to retain foreground IP would encourage more partners especially SME's and start-ups that cannot afford to lose IP, and it will attract innovators which, in their opinion, surely is the point.

Another of these respondents made a point that when a supplier talked on a project with a DNO to test their product on the network this will inevitably improve the product, but then the DNO will claim ownership of the IP of the improvement as they funded it. They, once again, say this is a big barrier for SMEs as they will not have the experience or resource to be able to negotiate a licence with the DNO. They suggested a way to avoid this is scoping projects so suppliers develop no foreground IP, claiming all of it back as background IP.

The IP points made in the previous question responses are also relevant here.

C.1.7.3 Other Barriers

One response stated that initially the barrier was that companies were not prepared to take the risk on the new initiative, but this is no longer a problem as the LCNF has become established.

One respondent was aware of organisations which could be potential partners if they were more familiar with the program; they feel more needs to be done to disseminate the knowledge outside of the more established channels.

Another respondent is aware that some companies are hesitant to prepare bids with project partners in case the partners feel they will have an open cheque come delivery. These companies would prefer an informal arrangement, with the work tendered out once the project has been awarded, but the problem with this is the contribution of the project partners to the scope and development will be less.

A barrier mentioned in the previous question responses was once again brought up by a different respondent – the lack of resources DNOs have for innovation projects, and having to prioritise day-to-day running of the business over that. They think this could possibly by remedied by an allowance for "key" disciplines such as those responsible for non-routine operation permits (NROs) and improved access to internal electrical and mechanical competency could be made. This respondent also brought up another point made earlier – the financial risk that project partners have to take on when it comes to projects – saying that they take on a financial risk beyond the budget of the innovation project.

Finally, one respondent listed the barriers as; a tight criteria preventing a variety of parties leading projects, the difficulty for an NGO to get involved due to the difference between DNOs and NGOs, and the DNO having to develop skills it did not possess previously in order to bring non DNO project partners up to speed and provide the support required.

C.1.8 Parts Of The LCNF Which Have Worked and Not Worked Well (Q1.8)

Questions:
In your view, which parts of the LCNF have worked well and which haven't? What would you change in retrospect and why?

C.1.8.1 Summary of Responses

The responses to this part of the questionnaire were extremely varied, with a large mix of views and suggestions. About one third of the respondents felt that overall the LCNF worked well.

Three respondents gave no response to this question, with one stating as a panel member they feed comments on this directly to Ofgem, and another feeling they did not have enough experience to answer.

C.1.8.2 LCNF Successful Aspects

One respondent feels that the LCNF, especially tier two, has successfully filled the gap between low TRL and high TRL projects. The same respondent thinks that the engagement enabled for customers and partners is unequalled by anything else, stakeholder engagement has been key for many of the projects.

This respondent believes the fund has resulted in solutions that have delivered value for money to consumers, and ensured low carbon generation can be connected to the grid. They say that RIIO-ED1 business plans included £641m worth of savings to customers as a result of innovation.

One response felt the most successful aspects of the fund were the competition in selecting the best projects, and DNOs being required to share learning and customer-funded IPR – thus developing a knowledge base and allowing projects to build on previous learning. Another success of the LCNF mentioned is the culture change within the DNOs – it has shifted to have more focus on customer benefits and brought a competitive element that was previously there.

C.1.8.3 LCNF Less Successful Aspects

The lack of reliability of trials that include people (as opposed to testing technology) was mentioned by one respondent. They felt that you cannot be confident that results are repeatable for trials of this nature as those involved are likely to be more enthusiastic than the general population, and the focus is likely to give an unsustainable level of engagement.

One respondent felt that Ofgem's demands regarding DNOs investment savings are too high as their final figure for investment savings by DNOs in the RIIO ED1 is, in general, greater than the figure the DNOs have committed to in their business plans. They need to ensure the incentive to reach the figure is enough for the network operators to allocate resources.

One respondent felt that the reward structure didn't seem to encourage enough companies to come forward. They also felt that the consultant involvement in the competition process was onerous, but the process was okay when that involvement decreased.

One aspect pointed out by a respondent as a weak point was the ability to convey the importance and benefits of the fund to potential participants and customer base, they believe this needs looked into and network companies should be encouraged to promote the benefits of projects to stakeholders.

The same respondent felt another difficulty is recruiting customers to get involved – suggesting that a more integrated approach could be developed such as shared customer recruitment platforms.

Intellectual property was brought up again by two respondents; the former feels it is not right for DNOs to hold the IP, believing it would be better for the consumers if a party that could bets exploit it held the IP. This respondent also thinks the competitive aspect of awarding projects may be discouraging some collaboration of the DNO's part. The latter believed changes to these rules could generate more ideas and more savings for the consumer.

C.1.8.4 LCNF Suggested Changes

Business as Usual

One respondent thought that Ofgem, in light of the lack of BAU solutions implemented, need to ensure the projects fit into the future plans of the network operators thus ensuring the consumers get value for money. Another respondent also points out the limited "business as usual" rollouts that have been seen, wondering what can be done to get operational stakeholders to buy in.

Another respondent feels that other incentives will be required for the UK to implement LCNF funded projects into business as usual.

Finally, one respondent makes the point that it should not be overlooked how challenging embedding technology as business as usual is. It includes dissemination, training, standards, operational and asset management policies, retaining accreditation, procurement policies as well as risk management.

Other Suggestions

One respondent would like to see the LCNF develop and take technology from research to delivery along the TRL spectrum.

It was suggested by a respondent that the idea guidelines are no longer so open; going forward the integration of proven innovative technology may be effective. This respondent also feels that there should be cross energy market vectors i.e. electricity, heat, combustible gases, as it is clear that to have successful low carbon network strategy there needs to be collaboration between various vectors.

Another respondent feels in the coming years it would be good to find other ways to enable suppliers more access to the competition.

Finally, one respondent believes that the regulator has to be more honest with DNOs at the project evaluation stage – they need to highlight concerns and ensure it reaches the appropriate level of seniority in the DNO. Also this respondent stressed the importance of providing a safe environment for failure of innovation.

C.2 Innovation in GB

C.2.1 Would The Innovation Projects Have Occurred Without The LCNF (Q2.1)

Questions:
To what extent do you believe that these innovation projects would have occurred without the LCNF? Are you able to provide examples to support your views?

C.2.1.1 Summary of Responses

Eleven of the respondents felt that the innovation projects would either not have occurred without the LCNF or not have gone ahead at such a scale/such a quick timeframe, or otherwise that the LCNF has definitely been a factor in the projects going ahead. With two respondents commenting on how the LCNF sped up the introduction of innovation projects, and two respondents remarking that the projects could not have been carried out to the same scale in the absence of the LCNF.

One of the respondents felt it was hard to say, but conceded that he did not think C2C or CLASS could have occurred without the safe environment provided by the LCNF.

One respondent believed the innovation developed could not have occurred with support and encouragement from the regulator; they feel this point was proven by the fact not the whole fund was spent.

Another respondent said it is hard to quantify, but there are indications that GB is at the leading edge of ‘smart grid’ innovation, which can be attested to the LCNF.

One respondent stated the fact that in 2009 (pre-LCNF) the UK spend per customer on investment in UK network innovations barely reached the EU average; and by 2012 it was some three times the average.

Three respondents felt that the level of innovation would have been small.

C.2.1.2 Changes in DNOS

Around one third of respondents made the point that the LCNF has driven the positive change in the DNOs making them open to innovation.

One of these respondents made the point that previous to the LCNF the senior management would have discouraged staff from trialling innovative solutions, and this change has provided an opportunity for third parties to demonstrate the solutions and expertise they can bring. Another respondent made a similar point in that the scale of the LCNF resulted in board level interest in the projects.

Another of these respondents felt the LCNF was key to the DNOs developing strong future networks teams, which they hope will continue to work on innovation in their DNO.

Finally, one of these respondents believes the incentives under the DNO were crucial to push this change, allowing new suppliers and technical solutions to be introduced.

C.2.1.3 Other Observations

A point was made by two respondents that the LCNF was essential to test innovative solutions at scale.

Another respondent feels that network operators would not have been inclined to fund the projects as the pay-back is too uncertain and long even if it does happen. Another response made the point that it is not clear where else funding would have come from if not the LCNF since they benefits normally go to regulated entities, saying the only alternative route could be a R&D allowance embedded in pricing reviews.

One respondent states that the LCNF can deploy technology so quickly since it usually builds on that with a reasonable TRL, as opposed to developing brand new discoveries.

Another respondent believes the LCND has brought about other benefits such as; resource development (young engineers as an example), investment in SME's, and growth in the number and variety of supply chain businesses engaging with the GDNs.

Finally, one respondent feels that certain technical advances would have occurred due to necessity or good business practice eventually, asset health for example and smart arena advances due to disruptive technologies.

C.2.2 Effect of LCNF on Private Sector Innovation (Q2.2)

Questions:
Do you believe the LCNF has prevented, or otherwise discouraged, private sector innovation? Are you able to provide examples to support your view?

C.2.2.1 Summary of Responses

Two thirds of the respondents that responded to this question felt that the LCNF had in no way prevented or discouraged private sector innovation, only three felt it may have.

C.2.2.2 Encouraged Innovation

Three respondents mentioned that they thought the LCNF had done the opposite and actually encouraged it – one of them felt the LCNF aligns private sector innovation with the needs of DNOs by providing them a platform to engage. Another respondent felt this is especially true with regard to Active Network Management and Demand Side Management, saying the fund has driven suppliers to support DNOs in projects and going forwards to BAU. Another respondent felt the LCNF providing the opportunity for companies to prove their technology only encouraged innovation. They continued on to say a trial they had been involved in prior to the LCNF would probably have made it to BAU if the LCNF had existed as it was just lacking evidence that DNOs would benefit from the technology.

C.2.2.3 Reservations

Two respondents felt that it may have discouraged it to a limited extent as a result of IP ownership. One of these respondents went on to say that since the LCNF encourages technology at a relatively high TRL, it can be a challenge for start-ups to develop ideas at a lower TRL level. They hope that Energy Systems Catapult can provide support in these instances. They concede that support for technology development and commercialisation is a bigger barrier to innovation than any issues with the LCNF mechanism.

Finally, one respondent is of the view that EIC ensures that projects that don't fit in with their political and commercial plan are side-lined.

C.2.3 Effect of Third Party Access to LCNF Funding (Q2.3)

Questions:
Do you think third party access to LCNF funding would improve the quality of innovation projects and if so why?

C.2.3.1 Summary of Responses

The responses were varied for this question, with the only consensus that DNO involvement is essential regardless of third party access. Around a third of respondents felt that access would improve the quality of projects, with three respondents feeling it would definitely not aid the quality.

One respondent had no clear view and one respondent did not answer this question.

C.2.3.2 Third Parties Already Have Access

Two respondents would class third parties as already having access through their partnership with DNOs. Both provided the example of the My Electric Avenue project which was led by a non DNO, EATL. Another respondent also mentioned that LCNF projects were often led by non DNOs.

C.2.3.3 Third Party Access Would Improve the Quality

One respondent felt that the funding structure and control of DNOs can sometimes hinder projects coming forward; also there are some projects that are not obviously beneficial to the DNO but are beneficial otherwise they are less appealing to DNOs, but this could lead to asset stranding across the sector.

Another respondent felt it could be provided but the rules would need to be strict.

One respondent feels that giving third party access would inject a new energy into the fund – projects would be looked at from a different perspective including that of the customers, not just the DNOs.

Another respondent felt that if a way to give third party access without taking away Ofgem's rights to exercise due governance over project delivery could be developed; third party access could bring a wider variety of proposals. The response carried on to say it needs to be ensured that the projects are delivered and the roll-out benefit is secured from the attendant IPR as funded by customers, for the good of the DNO customers.

Finally, one respondent believes that it would improve the quality as the current need to secure political support from the EIC is a hindrance.

C.2.3.4 Against Third Party Access

Three respondents felt it would not be a good idea. One of these respondents felt that having the network operator involved makes sense as it means the project is realistic and provides some credibility, also having no DNO on board would create hindrances when it came to testing. Another respondent agreed with this point saying that the danger would be funding unfeasible innovation. These points were further agreed with by another respondent stating it would be hard for third parties to see if solutions could be “business as usual” without GDN involvement. Another respondent in the group supported the credibility point saying winning over the DNOs who are responsible for their assets is a key element in the process.

One of the respondents did not think providing the funds to a third party that does not serve the consumers (who fund up to 90% of the project) would ensure equality, or ultimately benefit consumers. They feel that the best plan for a third party with a good idea is to partner with a DNO.

One respondent thinks that even though the access probably would generate more project ideas, IP ownership would most likely become a barrier.

Another respondent that felt access could possibly be beneficial made the point that the main area for improvement is the conceptual stage – and Ofgem are in a good position to check that the individual projects generate an output worth more than the sum of its parts.

Finally, a respondent believes though it could improve the quality, the screening process would need to be thorough as third parties tend to misconstrue current energy challenges.

C.3 Additional Comments

C.3.1 Additional Comments (Q3.1)

Questions:
Please make any additional comments in respect of the LCNF success or otherwise here.

C.3.1.1 Responses

Positive Comments

One respondent felt the projects funded by the LCNF return real benefits to the consumers who funded it. Another respondent echoed this point and also feels the competitive nature of the project selection process is very effective, if unusual in the utilities sector. This respondent also feels that the scale and stability of multi-year budgets for LCNF have definitely aided the success of the fund. Another respondent commented that they appreciate the fund and hope it continues. The success of the fund was pointed out by another respondent.

LCNF is Ongoing

One respondent made the point that the LCNF is ongoing so in order to ensure an all-encompassing view of the projects is presented you have to consider that it is still going, so the outcomes and benefits to the customer are not known for all projects.

Business as usual

One response stated that more needs to be done to ensure more projects reach business as usual, the response continued to say more value could be injected by Ofgem having a stronger leadership or a third party with a good holistic view of the industry to see how projects would fit together to achieve the low carbon objective.

Another respondent felt it important to ensure the time taken for projects to reach business as usual is not too long as the longer the time, the greater the risk of the supply chain that have delivered projects over the last 5 years.

Lifetime of the Fund

A respondent made the following point; how much longer should a direct innovation stimulus be required, at a point the best situation would be the regulatory model encouraging DNOs to allocate funds and resource for research and development on the basis that it would benefit both shareholders and consumers. The response continued to say existing IQI and Totex incentive mechanisms aside, it needs to be ensured that that the 'shareholder' benefits are not relaxed too quickly, as they need to encourage the shareholder to fund the investment and take on the implementation risk.

Support Low TRL Innovation

The importance of supporting low TRL innovation was brought up by one respondent as this leads to prototypes that can be built on through NIC/NIA trials.

Global Presence

One respondent remarked that the LCNF has put the UK in the prime spot when it comes to innovation in the power sector, now often chosen by global providers as the location for trialling and piloting new technology.

Another respondent) believed the focus should now be on taking advantage of export opportunities that the LCNF has generated; this will both alleviate the risk while UK DNOs transition solutions to BAU and promote UK export. Through experience of international trade shows (Middle East Electricity, Elecrama India, India Smart Grid Week, and European utility Week) a growth in interest has been seen in the UK energy sector and the technology developed and trialled under the LCNF, NIC and NIA.

EIC

The view of one respondent was that the EIC (as they say, protected by Ofgem) has taken on a role as gatekeeper and poacher when it comes to SME's successful projects, thus the system does not work.

Culture Change

One respondent felt that the culture still has a risk adverse engineering ethos and need to change to become a more diverse culture with active risk management.

Project Criteria

It was thought by one respondent that in order to encourage more diverse innovation, the project evaluation criteria could be relaxed.

C.4 Research Establishment Questions

C.4.1 Increased Engagement with DNOs (Q4.1)

Questions:
Has the LCNF increased your engagement with DNOs? Please provide examples where you can

C.4.1.1 Summary of Responses

Two of the three respondents stated that the fund did increase their engagement with DNOs, with the other making the point that it is clear there has been a lot of engagement with some research establishments.

One respondent said they have attended several talks where DNOs discuss LCNF projects.

The other respondent stated that that LCNF (more IFI) increased DNO engagement from the all-time low it reached post privatisation.

C.4.2 Fitting Into Existing GB Framework (Q4.2)

Questions:
Do you think the LCNF fits appropriately into the existing GB research framework?

C.4.2.1 Summary of Responses

One respondent felt that the LCNF incentivises the DNOs to take on work that would not yet justify commercial investment – but whether this is a good use of funding or not will become apparent over time.

One of other respondents thought this could have been done more smoothly. DNOs have said at EPSRC panels that they are not allowed to engage in low TRL innovation. They believed OFGEM innovation has a place in the Energy Innovation landscape, and links with the other initiatives, though it was a challenge to link it with TSB/InnovateUK funding even though this would be a good way to encourage the best innovation. Focused calls were promoted but were more successful under the IFI, which they believe was very successful as a part of the innovation landscape. The respondent believes there could be better access to innovation projects than through the UKERC research atlas and the SFG portal; this is currently being reviews by Energy Systems Catapult. The response continued onto say that it was not possible to work with ETI mainly due to IPR constraints, and they hope that the Catapults will be better even though they have heard of no joint initiatives so far.

The final respondent was of the opinion that the LCNF projects built heavily on innovation funding in several cases.

C.4.3 2020 European Research Programmes (Q4.3)

Questions:
What is your opinion of how the NIA (previously IFI) and the NIC (previously LCNF) fits with the Horizon 2020 European research programmes?

C.4.3.1 Summary of Responses

Only one respondent answered this question and they felt that the NIC and NIA do not fit in with the H2020, though they should. They believe improved links between the network operators and InnovateUK would aid this.

The other two respondents felt they did not have the knowledge to answer the question.

C.4.4 Gaps in Present UK and EU Funding (Q4.4)

Questions:
Aside from the above are there any other gaps or problems that you perceive in the present research funding arrangements in GB and Europe which are a barrier to successful innovation?

C.4.4.1 Summary of Responses

One respondent mentioned the tension of balancing the comparative regulation and the requirement to share learning.

Another respondent identified a problem in that industrial engagement with BIS (RCEP, EPSRC, and InnovateUK) has decreased under RIIO; this makes it hard to justify spending money on energy research. These reductions may lead to a lack of low TRL projects and thus less feedstock into the higher TRL projects that are funded under RIIO.

The final respondent felt that not enough support is given to social science by research councils.

C.4.5 International Innovation Funding Mechanisms (Q4.5)

Questions:
Are you aware of any international innovation funding mechanisms that should be considered in our evaluation?

C.4.5.1 Summary of Responses

One respondent highlighted a new mechanism being introduced – Mission Innovation – and thought it should be considered as a future mechanism to consider interaction with. It takes innovation from research to SME and is supported by big names such as Bill Gates; they have heard it referred to as “Breakthrough Energy”.

ANNEX D – TIER 2 PROJECT ASSESSMENTS

D.1 Introduction

A qualitative assessment has been undertaken of the Tier 2 projects against the following criteria:

1. Accelerates the development of a low carbon energy sector
2. Has the potential to deliver net financial benefits to future and/or existing customers
3. Generates knowledge that can be shared amongst all DNOs
4. Involvement of other partners and external funding
5. Relevance and timing
6. Effective project methodology, and effectiveness of implementation

The criteria were scored on a 1-5 basis and each criteria was weighted. A descriptor of the scores against the criteria and the weighting is detailed in Section D3. The overall scores can be found in Table 3, Section 4.1.

These criteria are based on the specific Tier 2 project requirements set out in the LCNF governance documents. Whilst it is recognised that some changes were made to specific criteria as the scheme evolved, the criteria above are felt to be a suitable way to assess all the projects.

Whilst the financial benefits are considered qualitatively they are not scored as they have been separately considered in the quantitative assessment, however the grouping between long term and short term benefits, and the overall beneficiaries identified in against this criteria are pertinent to this evaluation.

Some projects are incomplete, indeed some only started in 2014/5, so it has not been possible to allocate a score against each criteria, although a comment has been made where relevant.

The projects are grouped using the same categorisation as elsewhere in this report, however it should be recognised that for a number of these Tier 2 projects the innovation initiatives may cross several categories. The chosen category here is that which appears to provide the largest, and / or most immediate benefit.

D.2 Index

Distributed Generation

- Flexible Plug & Play.
- Low Carbon Hub.
- Kent Active System Management (KASM).
- Accelerating Renewable Connections (ARC).
- Network Equilibrium.

Fault Level Management

- Fault Level Active Response (FLARE).
- FlexDGrid.

Flexible Demand

- Capacity to Customers (C2C).
- Flexible Approaches to Low Carbon Optimised Networks (FALCON).
- My Electric Avenue.
- Solent Achieving Value for Efficiency (SAVE).
- Low Carbon London.
- Venerable Customers Energy Efficiency.

Asset Rating

- Flexible Networks for a Low Carbon Future.

Storage

- Sola BRISTOL.
- Smarter Network Storage (SNS).

Network Configuration

- Low Energy Automated Networks (LEAN).
- Flexible Urban Networks (FUN) LV.

Visibility

- LV Network templates.
- Smart Street (ETA).
- New Thames Valley Vision.

Voltage Control

- CLASS.
- Customer Lead Network Revolution (CLNR).

D.3 Tier 2 evaluation criteria

Tier 2 evaluation criteria

	1a	1b	2	3	4	5
Weighting	6		4	2	5	3
Title	Accelerates the development of a low carbon energy sector	Has the potential to deliver net financial benefits to future and/or existing customers	Generates knowledge that can be shared amongst all DNOs	Involvement of other partners and external funding	Relevance and timing	Effective project methodology, and effectiveness of implementation
Score 5 descriptor	The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits are credible and quantified.	Compelling evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to the majority of customers	Specific replication report(s) exist. These cover the main technical / commercial / stakeholder aspects as applicable. A learning dissemination event or webinar was held.	The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable External funding for > 10% of the project was obtained.	The project has been / is ready to roll out into BAU. Other DNOs have included the project in their business plans.	The project achieved all its successful delivery reward criteria (SDRC) and the variance was <10%
Score 4 descriptor	The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits not specifically quantified **OR** The project clearly facilitates one of the carbon benefits: Provide reactive power services/ Provide frequency response service/Defer asset reinforcement. The carbon benefits are credible and quantified	Compelling evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to selected group of customers	Specific replication report(s) exist. These cover the main technical / commercial / stakeholder aspects as applicable. There is no evidence of a learning dissemination event or webinar.	The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.	The project has been /is ready to roll out into BAU. The project has a high likelihood of being replicated by other DNOs.	The project achieved all its successful delivery reward criteria (SDRC) and there was no overspend >10%,however the variance was >10%
Score 3 descriptor	The project clearly facilitates one of the carbon benefits: Provide reactive power services/ Provide frequency response service/Defer asset reinforcement. The carbon benefits not specifically quantified	Evidence that the project is highly likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment)	A learning dissemination event or webinar was held but there are no specific replication reports	The project included one external partner covering some of the main technical / commercial / stakeholder aspects as applicable	The project is ready to roll out when the energy landscape requires the solution The project has a reasonable likelihood of being replicated by other DNOs	The project achieved all its successful delivery reward criteria (SDRC) but has an overspend of > 10%
Score 2 descriptor	The project just demonstrates carbon benefit with respect to increasing energy efficiency.	Evidence that the project may deliver short-term financial benefits to a limited group of customers (e.g. associated with asset replacement deferment)	The only replication information available is in the closedown report.	The project included one external partner covering one specific aspect.	The project has been / is ready to roll out into BAU when the energy landscape requires the solution The project has potential for replication in niche situations or by third parties.	The project achieved >80% of its SDRCs
Score 1 descriptor	The project does not clearly demonstrate any carbon benefits.	Little or no evidence that the project will deliver any significant benefit to customers at any time in future	No dissemination or replication documentation is evident.	The project did not involve any external partners.	This is a one off project with no potential for future replication.	The project achieved <80% of its SDRCs

D.4 Distributed Generation Connection

Flexible Plug and Play

Project Title	Flexible Plug & Play (FPP)
Tier	**2**
DNO	**UKPN**
Status	**Complete**
LCNF project funding	**£6,780k**
Project objectives	Develop a Strategic Investment Model which will allow DNOs to quantify, for different demand and generation scenarios, the integrated value and benefits of different smart technologies, smart commercial arrangements and smart applications. This model will also determine from both an economic and carbon perspective whether it is better to reinforce the network or use smart alternatives.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**5**	**Assessment:** *The project clearly facilitates the connection of low carbon generation.* *The carbon benefits are credible and quantified.* **Evidence:** The project has enabled £54 million worth of low carbon generation projects to be built that otherwise would not have been financially viable (assuming £1 per MW). The full submission pro-forma estimated that the FPP project could deliver 242 thousand tonnes of CO_2 emission savings by 2020. The closedown report provides some analysis the emissions and cost of different solutions (traditional network with no DG curtailment; connect and manage; FPP approach). **References:** ▪ FPP closedown report; 2015. ▪ FPP full submission pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *The project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to selected group of customers* **Evidence:** The techniques demonstrated in the project can save DG customers significant reinforcement costs and allow DG connections to take place that would have been non-viable without the flexible connection option. This will be applicable to networks and DG connections across GB. **References:** ▪ FPP closedown report; 2015.
Generates knowledge that can be shared amongst all DNOs	5	**Assessment:** *Specific replication report(s) exist. These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** Section 10 of the closedown report covers project replication. It outlines customer engagement, communication platform, Quadrature-booster, Dynamic Line Rating (DLR) and ANM solutions. The section references specific replication reports, such as the SDRC reports, high level design report, acceptance test report and trial report. The trial reports contain specific learnings. Dissemination to external stakeholders was carried out via conferences, SDRC learning reports, the project website, an innovation newsletter, one-to-one sessions with DNOs and key stakeholders and awards (shortlisted for five, won two). A learning event was organised at the end of the project. The learning has been used in the SPEN ARC project. **References:** ▪ FPP closedown report; 2015. ▪ Methodology & Learning Report; Work package 2.4: Integration of Voltage Regulators; 08 / 2015. ▪ Quadrature-booster Trial & Learning Report; Mar-15 ▪ Dynamic Line Rating Trial Report ▪ Novel Protection Relay Trial Report ▪ Communication Trial Report ▪ Strategic Investment Model for Future Distribution Network Planning; Dec-14 ▪ SDRC 9.6 Implementation of active voltage and active power flow management within FPP Trial area ▪ FPP – SDRC 9.7: Quicker and more cost effective connections of renewable generation to the distribution network using a flexible approach. ▪ SPEN Questionnaire response

Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable* *External funding for > 10% of the project was obtained.* **Evidence:** Partners included: Cable & Wireless Worldwide (IP Open Standards Platform), Silver Spring Networks (RF Radio mesh solution), Smarter Grid Solutions (power flow and voltage coordination management applications), GL Garrad Hassan (wind energy development expertise / stakeholder engagement), Alstom Grid (dynamic line rating and protection equipment), Fundamentals (Automatic Voltage Control (AVC) Scheme expertise), Converteam (technical and systems integration support), Cambridge University's Electricity Policy Research Group (EPRG) (economic, regulatory and competition analysis), Imperial College London (develop the FPP Strategic Investment Model), S&C Electric (equipment provision) and the IET (learning and dissemination partner). Links to key project learning documents are found in section 13 of the closedown report. External funding of £989k (~11% of total). **References:** ▪ FPP full submission pro-forma. ▪ Summary of the LCNF funds learning EATL, April 2016.
Relevance and timing	**5**	**Assessment:** *The project has been / is ready to roll out into BAU.* *DNO has included the project in their business plan – and is being considered by other DNOs.* **Evidence:** In their business plan, UK Power Networks committed to integrating Flexible Plug and Play connection offers (now known as Flexible DG connections) and have since accelerated the rollout of flexible DG connections in some areas. This is being managed by BAU teams. A total of 25 sites have accepted offers, representing more than 100MW of new generating capacity. Techniques from the project are being used by SPEN ARC. **References:** ▪ FPP closedown report; 2015. ▪ SP Energy Networks Innovation Strategy, March 2014 ▪ UKPN Questionnaire response

Effective project methodology, and effectiveness of implementation	**5**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and the variance was <10%* **Evidence:** All SDRC have been completed and a report published for each. Original budget: £8.9m. The total cost of the project was £8.493m, so -4.6%. **References:** ▪ FPP closedown report; 2015.

Low Carbon Hub

Project Title	Low Carbon Hub (LCH)
Tier	2
DNO	WPD
Status	Complete
LCNF project funding	£2,837,629
Project objectives	**Optimising renewable energy resources in Lincolnshire.** The Low Carbon Hub had the following Scope and principal Objectives: ▪ Active smart design and network operation to allow generation to be connected to the distribution network more economically. ▪ Optimise distribution network for demand and generation whilst demonstrating solutions to some of the network limitations, ▪ Increase visibility and control of the 33kV system and reduce network losses, and ▪ Demonstrate previously unproven high voltage network assets.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation.* *The carbon benefits not specifically quantified.* **Evidence:** The project facilitated the connection of low carbon generation by developing a distribution network optimised for demand and generation reducing technical network losses. Carbon benefits are not specifically quantified. **References:** ▪ Low Carbon Hub project closedown report, 27th May 2015. ▪ Summary of the LCNF funds learning EATL, April 2016. ▪ LCH; Full Submission Pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *The project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to selected group of customers.* **Evidence:** The project delivers benefits to DG customers by unlocking additional cost effective capacity for new DG. At project closure, the project had facilitated an additional 48.8MVA of new generation connections using some of the new innovative methods trialled. The project is therefore considered likely to provide long term financial benefits to the group of customers who wish to connect new generation. **References:** ▪ Low Carbon Hub project closedown report, 27th May 2015.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** Project replication is covered in section 10 of the closedown report and is supported by appendices. An email address is provided for those looking for further detail relating to any physical component or knowledge requirements. The details in the report cover commercial arrangements, brief details and equipment/products used in the various methods trialled. Links are available to key project learning documents in the closedown report. These include a design justification report and a specific knowledge dissemination report Project specific dissemination events have been held for the wider industry and DNOs, including a large dissemination event at the end of the project. Several press and magazine articles have been written, the project has been disseminated learning at numerous industry wider conferences and the project has disseminated learning directly to other DNOs in 1 to 1 meetings at their offices. The learning has been used in the SPEN ARC project. **References:** ▪ Low Carbon Hub project closedown report, 27th May 2015. ▪ SDRC disseminate knowledge and evaluate the potential for similar projects throughout the UK, 30th January 2015. ▪ Project Lincolnshire Low Carbon Hub; Design Justification Report; 28th May 2013. ▪ SPEN Questionnaire response

Involvement of other partners and external funding	**4**	**Assessment:** *The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.* **Evidence:** The summary of the LCNF funds learning EATL report does not highlight any partners. However, the LCH; Full Submission Pro-forma does note some external collaborators and partners: ▪ A FACTs provider who will supply, implement, commission, operate and maintain the FACTs device and network filters. ▪ Distributed generators ▪ Local authority ▪ Fundamentals Ltd, who is a technical partner. From the closedown report: ▪ A S&C 3.75 MVAr PureWave DStatcom device was supplied and used in the project. Exact details of the provider who installed and will maintain are not clear in the closedown report. ▪ Fundamentals Ltd supported the development of the DVC method due to their detailed knowledge of Voltage Control relays. They created the DVC algorithm for both hardwired and DNP3 control. ▪ Connections were offered to 34 DG and accepted by 5. ▪ May be limited involvement of the LA, but was a workshop to over 90 local authority planners. Overall, it appears that there are two main technical partners covering equipment provision and part of the project design. From the full submission pro-forma, it appears that £30,000 of external funding was received from the FACTs provider. **References:** ▪ Low Carbon Hub project closedown report, 27th May 2015. ▪ Summary of the LCNF funds learning EATL, April 2016. ▪ LCH; Full Submission Pro-forma.

Relevance and timing	**4**	**Assessment:** The project has been / is ready to roll out into BAU. The project has a high likelihood of being replicated by other DNOs. **Evidence:** The learning from the LCH has shown there is both a significant appetite and opportunities to further implement Alternative Connections across the wider areas to cost effectively unlock further generation capacity. The implementation is most suitable to areas where there are already widespread network constraints, significant demand for further generation connections and diversity between demand and generation profiles. Within Western Power Distribution, Alternative Connections were not previously considered a Business as Usual activity. East Lincolnshire was the first ANM implementation and there has been a commitment to implement Alternative Connections across all four WPD licence areas with 11 new zones opened by 2023. Each will use the Alternative Commercial agreements developed as part of the project. As part of the internal implementation, ANM policies and Standard Techniques have been written for offering alternative connections as a BaU process, WPD's 200+ planners have been trained how to offer alternative connection offers, and WPD has changed its core database to facilitate the alternative connections. WPD is developing a core constraints analysis tool that will eventually be used for calculating constraints in all ANM areas using the learning generated from the project. At the end of the project, all DNOs have been offered one to one meetings in their offices to further disseminate WPD's, and their own, learning. In developing WPD's Alternative Connections, discussions were held with both SSE and UKPN to help coordinate the development and trials of new commercial agreements as part of innovative projects. Importantly, these discussions also helped us and these other DNOs benefit the customer by standardising on new commercial terms and language. The direct feedback from the DNOs and wider stakeholders at WPD's commercial agreements dissemination events supported this approach. Discussion and feedback indicated that the project appears to have high likelihood of being replicated by other DNOs. **References:** ▪ Low Carbon Hub project closedown report, 27th May 2015.

Effective project methodology, and effectiveness of implementation	**5**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and the variance was <10%.* **Evidence:** The SDRC, proposed evidence and actually are provided in section 5.3 of the closedown report. This details where further information and evidence can be found. Project has achieved all its SDRC. Costs are outlined in section 7 of the closedown report. ▪ Total Budget: £3,417k ▪ Total Spend: £3,667k ▪ Variance: overspend of £250k (7.3%) **References:** ▪ Low Carbon Hub project closedown report, 27th May 2015.

Kent Active System Management

Project Title	Kent Active System Management (KASM)
Tier	**2**
DNO	**UK Power Networks**
Status	**New**
LCNF project funding	**£3,345k**
Project objectives	The Kent Active System Management (KASM) project will trial an innovative application of a software tool, real-time contingency analysis, in a DNO control room. Transmission system operators currently use a variant of this tool to actively manage the reliability of complex transmission networks. The KASM project will deliver enhanced visibility and analysis capabilities regarding the power flows and stability of the 132 kV network to control room engineers and outage and network planners. These capabilities will enable UK Power Networks to: • Manage the network in real-time in order to improve reliability; • Reduce congestion and better manage planned and unplanned network outages; and • Improve long-term planning capabilities to anticipate network capacity issues thus improving the reliability and capacity of the network.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**5**	**Assessment:** *The project clearly facilitates the connection of low carbon generation.* *The carbon benefits are credible and quantified.* **Evidence:** The KASM method and real-time contingency analysis platform is intended to provide deeper insight into the behaviour of East Kent network and provide more flexibility in terms of how it is managed to allow a greater range of options to expedite future renewable generation connections. Linear extrapolation of the benefits estimated for the East Kent region, results in an estimated carbon emissions savings of approximately 275,000 tonnes of CO_2. **References:** ▪ KASM full submission pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers		**Assessment:** *The project is likely to deliver significant financial benefits in the long term (ED2 and beyond) to a selected group of customers* **Evidence:** The financial benefits are associated with deferral of provision of additional Grid Transformer capacity, the connection of generation and more efficient outage planning processes **References:** ▪ KASM full submission pro-forma. ▪ Summary of the LCNF funds learning EATL, April 2016.
Generates knowledge that can be shared amongst all DNOs		*Project incomplete not marked*
Involvement of other partners and external funding	**4**	**Assessment:** *The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.* **Evidence:** Project Partners: National Grid (provision of real-time information); Navigant Consulting (Europe) Ltd (project assistance). Project Suppliers: Bigwood Systems Inc. (supplier of analysis software). Schneider Electric (reserve supplier). Full submission pro-forma shows external funding of £45k (1.15% of total project cost cited (£3,898). **References:** ▪ KASM full submission pro-forma.
Relevance and timing		*Project incomplete not marked*
Effective project methodology, and effectiveness of implementation		*Project incomplete not marked*

Accelerating Renewable Connections (ARC)

Project Title	Accelerating Renewable Connections (ARC)
Tier	**2**
DNO	**SPEN**
Status	**Ongoing (Dec 2016)**
LCNF Project funding	**£6.253m**
Project objectives	ARCs objective is to improve access and the time to connect generation to the distribution network

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation. The carbon benefits not specifically quantified* **References:** ▪ Summary of the LCNF funds learning EATL, April 2016 ▪ LCNF Full Submission Pro-Forma **Evidence summary:** Key project objectives: ▪ Improve access to connect generation ▪ Accelerate the time to connect generation ▪ Enable connections to be facilitated around constraints Awarded Best Innovation project by the Scottish Green Energy Awards December 2015 The carbon benefits are associated with low carbon generation offsetting carbon generation.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *The project is likely to deliver significant financial benefits in the long term (ED2 and beyond) to a selected group of customers* **Evidence summary:** The business case is case study specific and is based on the improved speed of connection and reduced network reinforcement cost. As the project has not completed this is not yet known, however the publically available information identifies that the project has allowed a range of type and sizes of generation to connect using a variety of ANM solutions. The duration of the benefits depends on the business case of the generator and the specificities of the network to which it is connecting – in some instances if the constraints are significant it may be that the network is upgraded at some point in the future with a resultant firm, non managed connection and hence just an accelerated connection is achieved. In some cases the solution may be permanent. **References:** ▪ LCNF Full Submission Pro-Forma ▪ December 2014, 6 monthly project progress report ▪ http://www.arc-project.com/green-energy-award/ ▪ Presentation 1 – Euan Norris ARC workshop 17_03_2016
Generates knowledge that can be shared amongst all DNOs	-	**Assessment:** *Project incomplete not marked* Workshop held: ▪ Accelerating Renewable Connections, Commercial Mechanisms & Constraints Analysis Workshop 17/3/16 Project is using WPD LV network template techniques.

Involvement of other partners and external funding	**4**	**Assessment:** *The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.* **Evidence:** Wide range of external partners: Community Energy Scotland ▪ Generator engagement Smarter Grid Solutions ▪ Analysis tool development University of Strathclyde ▪ Data evaluation ARC Full Submission Proforma Second Tier funding request: ▪ LCN Fund: £7.421 million ▪ SPEN: £million ▪ Project Partners' contribution: £0.321million **References:** Original Low Carbon Networks Fund submission form SPEN – ARC

Relevance and timing	-	**Assessment:** *Project incomplete not marked* *However DNOs have already or are intending to adopting ANM techniques shortly and whilst the project in its entirety is not ready to roll out into BAU it has a high likelihood of being replicated by other DNOs.* **Evidence:** Requirement for connection of renewable generation is highest in Scotland and is GB wide. Many different constraints exist on many different networks causing reasonably priced, timely connection challenges. The project team have been actively engaged with the ENA in the creation of an ANM 'best practice guide'. Through the project, a number of challenges have been identified around the interface between the DNO's/SO and TO's, prompting activity around exploring the requirements for greater local system control and balancing in the form of a Distribution System Operator (DSO) which are being further investigated in the NIA Evolution project. The adoption of Active Network Management as well as new commercial arrangements with our customers is identified as a key enabler in the formation of our Future Smart Grid Strategy and has created the formation of two live steering groups; ▪ SPEN DSO Steering Group – Strategic development of technical and commercial roadmap to DSO. ▪ SPEN Smart Grid Steering Group – Development and roll-out of strategic technology enablers to prepare the distribution network for further growth in LCT, DG and new local balancing markets under a DSO Through ED1 and into ED2 new commercial arrangements will be implemented to allow DG and Distributed Energy Resource (DER) customers to connect to the distribution system without the need for network reinforcements; arrangements such as 'managed' connections against local system constraint, 'managed' connections against wider transmission constraint in the form of enhanced Statement of Works process and the facilitation of local community energy schemes being able to couple demand and generation in the form of 'Virtual Private Wire' or 'Sleeving' arrangements. However, SPEN believe that uncertainty around an evolving energy market must be considered when implementing a BaU roll-out strategy in order to avoid future conflict between 'managed' connections and future actions taken by the system operator (SO) or local system operators in the form of a (DSO). **References:** Active Network Management Guide; Presentation 1 – ARC workshop 17_03_2016; Questionnaire
Effective project methodology, and effectiveness of implementation	-	**Assessment:** *Project incomplete not marked*

Network Equilibrium

Project Title	**Network Equilibrium**
Tier	**2**
DNO	**Western Power Distribution (WPD) South West**
Status	**New**
LCNF project funding	**£11,480k**
▪ Project objectives	▪ The aims of Equilibrium are to: ▪ Increase the granularity of voltage and power flow assessments, exploring potential amendments to ENA Engineering Recommendations and statutory voltage limits, in 33kV and 11kV networks, to unlock capacity for increased levels of LCTS); ▪ Demonstrate how better planning for outage conditions can keep more customers connected to the network when faults occur. This is particularly important as networks become more complex, with intermittent generation and less predictable demand profiles, and there is an increased dependence on communication and control systems; ▪ Develop policies, guidelines and tools, which will be ready for adoption by other GB DNOs, to optimise voltage profiles across multiple circuits and wide areas of the network; ▪ Improve the resilience of electricity networks through flexible power link (FPL) technologies, which can control 33kV voltage profiles and allow power to be transferred between two, previously distinct, distribution systems; and ▪ Increase the firm capacity of substations, which means that the security of supply to distribution customers can be improved during outage conditions, leading to a reduction in customer interruptionsand customer minutes lost (CMLs).

▪ Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits not specifically quantified.* **Evidence:** The three Methods being tested in this Project will unlock capacity to facilitate the integration of low carbon technologies (both demand and generation). The Methods could also alleviate voltage and/or thermal constraints related to CHP plant, to support the development of district heating networks, particularly in urban areas. The Equilibrium Methods could facilitate the integration of DG close to large demand centres, and hence close to the point of need. Benefits in terms of MW/GW and £ are outlined in the full submission pro-forma, but carbon benefits are not specifically quantified. **References:** • NE full submission pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *The project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to selected group of customers* **Evidence:** The financial benefits are mainly associated with connection of generation. **References:** ▪ NE full submission pro-forma.
Generates knowledge that can be shared amongst all DNOs	-	*Project incomplete not marked* However the project is building on the learning from CLASS, Smart Street, Flexible Urban Networks and Flexible Plug and Play
Involvement of other partners and external funding	-	**Assessment:** *The project currently involves some external supporters, although additional project partners and the roles of partners has not been defined.* **Evidence:** The full submission pro-forma states that project collaborators, service providers and equipment suppliers will be selected using a competitive tendering process. No External Funders have been identified. Project Supporters include: National Grid; Scottish Power Energy Networks; Newcastle University; and Parsons Brinckerhoff. Roles of project supporters are not specifically outlined. No external funding is cited in the full submission pro-forma. **References:** ▪ Full submission pro-forma.
Relevance and timing		*Project incomplete not marked*
Effective project methodology, and effectiveness of implementation		*Project incomplete not marked*

D.5 Fault Level Management

Fault Level Active Response (FLARE)

Project Title	Fault Level Active Response (FLARE)
Tier	2
DNO	Electricity North West
Status	New
LCNF project funding	£4,425k
Project objectives	FLARE has four objectives: 1. To trial the Fault Level Assessment Tool software; 2. To trial two technical and one commercial techniques which, when deployed on existing network infrastructure, will provide effective and efficient fault level control; 3. To deliver novel and highly transferable solutions that can be applied to the HV and EHV networks by any GB DNO; and 4. To demonstrate release of network capacity allowing quick and lower cost connection for customers' demand and generation, enabling DNOs to support the UK's decarbonisation strategy.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	5	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits are credible and quantified.* **Evidence:** The project will avoid the need for reinforcement due to fault level constraints by using retrofitted techniques and enable quicker connection of LCTs. The full submission proforma states that FLARE could release 127,275MVA of capacity for the connection of customers' new low carbon generation and demand (across Great Britain) and 9,517MVA in the Electricity North West area. The full submission proforma provides a preliminary scoping of the carbon impact of Flare, which quantifies carbon impacts in a number of graphs. The 2013 IET technical report Electricity Networks – Handling a Shock to the System, states that managing the impacts of high fault levels will become increasingly challenging. **References:** ▪ FLARE full submission pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Likelihood that the project will deliver significant financial benefits in the long term (ED2 and beyond) to the majority of customers* **Evidence:** Financial benefits vary depending on which fault level mitigation technique can be applied, but all are based upon the avoidance of full network reinforcement. **References:** ▪ FLARE full submission pro-forma. ▪ Summary of the LCNF funds learning EATL, April 2016.
Generates knowledge that can be shared amongst all DNOs		Not assessed – project ongoing
Involvement of other partners and external funding	**4**	**Assessment:** *The project involved a wide range of external partners covering some of the main technical /commercial / stakeholder aspects as applicable.* **Evidence:** Project Partners: ABB (equipment supply and maintenance, technical support, learning and dissemination); Parsons Brinckerhoff (consultancy support, learning and dissemination); ENER-G (test cell, customer engagement/surveys, engineering support); Impact Research (customer activities, data collection, learning and dissemination); Combined Heat and Power Association (customer recruitment and engagement/surveys); Schneider Electric (software and hardware, learning and dissemination); United Utilities (technical and customer engagement). Project Supporters: The University of Manchester School of Electrical & Electronic Engineering; Tyndall Manchester Centre for Climate Change; Greater Manchester Combined Authority Full submission pro-forma shows external funding of £515k (9.3% of total project cost cited (£5,539k)). **References:** ▪ FLARE full submission pro-forma.
Relevance and timing		Not assessed – project ongoing
Effective project methodology, and effectiveness of implementation		Not assessed – project ongoing

FlexDGrid

Project Title	FlexDGrid
Tier	2
DNO	WPD
Status	Ongoing (March 2017)
LCNF Project funding	£13.513m
Project objectives	FlexDGrid's objective is to develop and trial an advanced fault level management solution to improve the utilisation of the 11 kV networks

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	5	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits are credible and quantified.* **References:** ▪ Summary of the LCNF funds learning EATL, April 2016 ▪ LCNF Full Submission Pro-Forma **Evidence summary:** Key project objectives: ▪ Lower cost to connect generation ▪ Accelerate the time to connect generation ▪ Reduce CMLs and CIs ▪ Facilitate the connection of Combined Heat and Power (CHP) generation to enable the supply of heat in new developments in Birmingham. The carbon benefits are associated with low carbon generation offsetting carbon generation and the provision of heat offsetting the direct use of gas in properties.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Likely that the project will deliver significant financial benefits in the long term (ED2 and beyond) to the majority of customers* **Evidence summary:** The financial benefits are associated with the deferral of reinforcement due to fault level constraints. The benefit varies depending on which fault level mitigation method is used. Benefits are also obtained due to the facilitation of connection of CHP plants in central Birmingham. Learning associated with fault level management could be beneficial to all customers in the long term. **References:** ▪ LCNF Full Submission Pro-Forma
Generates knowledge that can be shared amongst all DNOs	-	**Assessment:** *Project incomplete not marked*
Involvement of other partners and external funding	4	**Assessment:** *The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.* **Evidence:** External partners: Parsons Brinkerhoff, Network modelling, technical advice and support and University of Warwick, Real-time fault level monitoring, fault level management and mitigation strategies, district heating survey. Range of other suppliers. FlexDGrid Full Submission Proforma Second Tier funding request: ▪ LCN Fund: £13.513 million ▪ Project Partners' contribution: £1.670million **References:** Original Low Carbon Networks Fund submission from WPD – FlexDGrid Six monthly progress report June 15- Nov 15
Relevance and timing	-	**Assessment:** *Project incomplete not marked* However the project aim continues to facilitate the connection of Combined Heat and Power (CHP) generation to enable the supply of heat in new developments in Birmingham
Effective project methodology, and effectiveness of implementation	-	**Assessment:** *Project incomplete not marked*

D.6 Flexible Demand

Capacity to Customers (C2C)

Project Title	Capacity to Customers (C2C)
Tier	2
DNO	ENW
Status	Complete
LCNF Project funding	£8.6m
Project objectives	The C2C Method is a new form of demand response which releases capacity through a combination of innovative network management technologies in conjunction with new customer commercial arrangements.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits are quantified.* **References:** ▪ C2C Project Close down report, 7 August 2015, ▪ Summary of the LCNF funds learning EATL, April 2016 **Evidence summary:** Benefits linked to low carbon energy sector: ▪ Enables load and generation to be connected without traditional HV and EHV reinforcement ▪ Defer asset reinforcement The C2C Solution enables network capacity to be released without traditional reinforcement. thus facilitating emissions savings from low carbon technologies such as heat pumps and renewable electricity generation. “Based on advancing connections by around six months, the C2C Method could directly claim to facilitate 39-67 thousand tCO2e of emissions reductions in Electricity North West network area (depending on how the capacity is used).”

Has the potential to deliver net financial benefits to future and/or existing customers		**Assessment:** *Compelling evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to the majority of customers* **Evidence summary & References:** "The principal benefit to customers of the C2C 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." It is estimated that 3.1 GW of capacity could be release on the ENWL network
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence summary & References:** Knowledge dissemination events: C2C April 2013 and January 2015. Section 10 of the closedown report covers project replication. Section 13.2 of closedown report has references to key learning Appendix G of the closedown report (Peer review by NPG) refers to an implementation guide.
Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable* *External funding for > 10% of the project was obtained.* **Evidence:** Wide range of external partners: General Electric (GE) – Lead technology supplier Parsons Brinkerhoff – Engineering planning and design Flexitricity – Post-fault demand response service provision EnerNOC – Post-fault demand response service provision NPower – Support to EnerNOC and Flexitricity National Grid – Assistance with consideration of network codes and standards. The University of Manchester – Capacity assessment The University of Strathclyde – Network modelling and studies The Tyndall Centre for Climate Change – Carbon impact assessment

		Impact Research Customer engagement and analysis C2C Full Submission Proforma Second Tier funding request: ▪ LCN Fund: £9.109 million ▪ Electricity North West Contribution: £1.028 million ▪ Project Partners' contribution: £0.489million **References:** C2CClose down report Original Low Carbon Networks Fund submission form ENWL – C2C C2C website
Relevance and timing	**4**	**Assessment:** *The project has been /is ready to roll out into BAU.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The C2C Method is part of a suite of strategic interventions to defer or avoid network reinforcement issues. Networks are analysed on an individual basis, as generalisation of benefits is not accurate and very much specific to the combination of network composition, topology and demand locations. Company planning policy is being updated to reflect the requirements of the C2C Solution. The C2C commercial offering has become the standard solution for all DG new connections and principles are being moved into demand connections. **References:** C2CClose down report & ENWL response to evaluation questions
Effective project methodology, and effectiveness of implementation	**4**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and there was no overspend >10%,however the variance was >10%* **Evidence:** Total project variance 16% (underspend) due to project efficiencies All SDRC's were met during the project but an extension to the project timescale was required during the project to enable ten new customer contracts to be signed and full learning to be gained. **References:** C2CClose down report

FALCON (Flexible Approaches for Low Carbon Optimised Networks)

Project Title	FALCON (Flexible Approaches for Low Carbon Optimised Networks)
Tier	2
DNO	WPD
Status	Complete
LCNF project funding	£12,399k
Project objectives	FALCON sought to demonstrate how smart techniques could be used to remove constraints on the 11kV network thereby removing barriers that may hinder the uptake of low carbon technologies and therefore the transition to a low carbon future. It addressed this by firstly using various techniques (engineering and commercial) on the network and then using the results of these trials to inform a new modelling tool that was specifically built to help planners(both operational and strategic). The project had 9 key objectives.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits not specifically quantified.* **Evidence:** The objective of the project was to demonstrate how smart techniques could be used to remove constraints on the 11kV network thereby removing barriers that may hinder the uptake of low carbon technologies. It therefore facilities the connection of low carbon generation or demand. The full submission pro-forma highlighted that the project will save over 680k tonnes of CO_2 by 2050. This figure is repeated in the closedown report. However, actual, achieved carbon benefits are not specifically quantified at the end of the project – either in the closedown report or the final report. **References:** ▪ Project FALCON closedown report; December 2015. ▪ FALCON Full Submission Pro-forma.
Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Evidence that the project is highly likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment).* **Evidence:** Customers will benefit from lower than predicted DUoS charges as a result of the use of alternatives to conventional reinforcement. In addition, those customers served by meshed networks or networks to which

		automated load transfer has been applied are likely to experience reduced customer interruptions (CI and customer minutes lost, CML). SIM results show that where smart techniques are used in conjunction with traditional reinforcement the investment costs are reduced compared to analysis where only traditional reinforcement is used. This saving varies significantly between primaries but is in the order of 20% An overall reduction in CML and CI is seen where meshed networks are applied. It is considered that the majority of customers can benefit from lower than predicted DUoS charges, while an additional group will also receive benefit from reduced customer interruptions. The closedown report states that the results from FALCON suggest that there are only short term benefits from the use of the trials over conventional reinforcement. **References:** ▪ Project FALCON closedown report; December 2015.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication reports exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** At least 11 separate final reports exist on different technical elements of the project. These were all published in May2015. They introduce the method trialled, outline design, construction and commissioning, give an overview of trial operations, as well as results, discussion, comparisons, conclusions and recommendations (as appropriate). Customer engagement is also discussed in those reports where relevant. There was also a knowledge capture and dissemination report, published in September 2015. WPD has undertaken a final presentation on FALCON in which DNOs were invited to provide feedback. In addition the Overall Final Report (not the detailed underlying ones) has been peer reviewed by project partners and feedback taken on board where appropriate. The Close down Report has been peer reviewed by SP Energy Networks. WPD has a FALCON based exhibition at the 2015 LCNI Conference in Liverpool and used this to share knowledge with other DNOs and Stakeholders. This has led directly to requests for bilateral events including with National Grid. **References:** ▪ Project FALCON closedown report; December 2015. ▪ Final reports for various methods trialled; May 2015 – Energy Storage; Load Estimation; Automatic Load Transfer; SIM Workstream; Commercial Trials; Dynamic Asset Rating Overhead Lines; Dynamic Asset Rating Distribution Transformers; Dynamic Asset Rating Cables; Dynamic Asset Rating Primary Transformers; WiMAX Based Telecommunications System; Meshed Networks. ▪ Knowledge Capture and Dissemination report; September 2015.

Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable.* *External funding for > 10% of the project was obtained.* **Evidence:** The full submission pro-forma outlines the following partners and their roles as follows: ▪ Cranfield University: lead the design and build of the Scenario Investment Model (SIM) ▪ Aston University: Construction of the simulation harness for the initial defined network ▪ Alstom: development of the dynamic asset management, automated load transfer and meshed network. ▪ GE Digital Energy: design and supply of Energy Storage Systems (ESS) ▪ CISCO: design and supply of the communications infrastructure; cyber security testing of the communications infrastructure. ▪ Logica: Project support functions for overall project, as well as Quality and Benefits Management. Assistance in obtaining and processing existing settlement data. Logica is also an implementer of DPLAN, one of the network modelling tools considered for the SIM. ▪ University of Bath: knowledge capture, dissemination and customer engagement ▪ ELEXON: obtaining customer settlement data; provide access to the systems required to process and aggregate this data. ▪ ElectraLink: responsible for the development of enhanced customer load profile. ▪ Milton Keynes Council (project sponsor) will be stimulating targeted initiatives. ▪ JRC: provision of radio planning and frequency allocation for the telecommunications infrastructure Partners' roles are also discussed in parts of the closedown report and the EATL report highlights a similar list of project partners. The full submission pro-forma highlights external funding of £2,064k (>10% of project costs). **References:** ▪ Project FALCON closedown report; December 2015. ▪ Summary of the LCNF funds learning EATL, April 2016. ▪ FALCON Full Submission Pro-forma.

Relevance and timing	**3**	**Assessment:** *The project is ready to roll out when the energy landscape requires the solution.* *The project has a reasonable likelihood of being replicated by other DNOs.* **Evidence:** WPD is discussing with the business how the learning from FALCON can be implemented, where appropriate. Changes in policy have been identified throughout the lifecycle of FALCON and WPD intend to take all learning possible into the business. Areas have been identified where they believe there will be some benefit to wider use: ▪ The SIM is being explored as a strategic planning tool. ▪ Dynamic Asset Rating is being further trialled. ▪ Follow on projects to explore the benefits / disbenefits of DSR are being considered, or under way. ▪ Telecommunications are under consideration and a number of initiatives are under way to explore the optimal way forward. The closedown report highlights that FALCON generated learning applicable to all DNOs, shared through established LCNF dissemination channels. However, there is currently no indication that other DNOs have included the project in their business plans, or of the likelihood that the methods will be replicated by other DNOs. **References:** ▪ Project FALCON closedown report; December 2015. And the WPD Questionnaire response
Effective project methodology, and effectiveness of implementation	**5**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and the variance was <10%* **Evidence:** The SDRC, proposed evidence and actually are provided in section 2.4 and 5.1 of the closedown report, with a description of how these have been met. Links to all final reports are highlighted in section 15.5, although the SDRC status comments do not specific highlight which reports are relevant to which criteria. However, the project has achieved all its SDRC. Costs are outlined in section 7 of the closedown report. ▪ Total Budget: £14,123k (from full submission pro-forma T2 funding request was £12,399k and external funding £2,064k = £14,463k) ▪ Total Spend: £13,423k ▪ Variance: underspend of £700k (-5%) due to reduced costs in some areas. **References:** ▪ Project FALCON closedown report; December 2015.

My Electric Avenue

Project Title	**My Electric Avenue**
Tier	**2**
DNO	**SSEPD**
Status	**Complete**
LCNF Project funding	**£4.5m**
Project objectives	The project developed a novel commercial agreement whereby a non-Distribution Network Operator (DNO) could manage an innovation project on behalf of a DNO; and trialled an innovative technology to manage the demand of electric vehicles on the local electricity network.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	5	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits are credible and quantified* **References:** ▪ SSET205 – My Electric Avenue (I2EV) Project Close-Down Report, April 2016, ▪ Successful Delivery Reward Criteria 9.8 An assessment of how much headroom an Esprit type solution would yield, November 2015 ▪ Summary of the LCNF funds learning EATL, April 2016 **Evidence summary:** Benefits linked to low carbon energy sector: ▪ Gain learning in respect of electric vehicle charging (domestic and commercial) ▪ Manage electric vehicle charging to manage system peak and associated thermal and or voltage constraints resulting in deferral of asset reinforcement **Carbon Impact:** Electric vehicle trial participants have drove over 3 million kilometres, saving more than 104 tons of direct CO_2 equivalent emissions. The application of Esprit (in its current state as a system with a controller and ICB) in place of network reinforcements is projected to save between 11.4 and 19.5 tons CO_2e emissions by the end of 2030 depending on the reinforcement required. By 2050 the carbon emissions savings are expected to be between 814 and 1,390 tons CO_2e.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *The project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to a significant group of customers.* **Evidence summary:** Financial benefits detailed in SDRC 9.8 report and summarised in Summary of the LCNF funds learning report: ▪ Financial benefits estimated mainly to occur in ED3 and ED4 ▪ Benefits associated with deferral of Totex ▪ Applicable on GB wide scale. This assumes that a significant number of customers take up electric vehicles in the ED3 and ED4 timescales. **References:** Successful Delivery Reward Criteria 9.8, An assessment of how much headroom an Esprit type solution would yield, November 2015
Generates knowledge that can be shared amongst all DNOs	5	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence summary & References:** Section 10 of the closedown report covers project replication from both the technical and commercial aspects. Section 12 of closedown report details the project dissemination events which took a wide range throughout the project: ▪ Project newsletters, E-mail, press release, social media, webinars, videos ▪ Finale event at The Institution of Mechanical Engineers, December 2015 ▪ Presented and represented at a multitude of industry events including the LCNI, IPT, Cenex LCV, IET HEVC, IET Electric Vehicles, Cholmondeley Pageant of Power ▪ Strategic meetings held with Ofgem, SSEPD, DECC, OLEV and other DNOs

Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable* *External funding for > 10% of the project was obtained.* **Evidence:** The project was developed and delivered as a partnership Project by EA Technology and Southern Electric Power Distribution. There was a wide range of external partners: Fleetdrive Electric ▪ Recruitment of participants and provision of EVs Zero Carbon Futures ▪ Recruitment of participants and installation and maintenance of charging points Nissan ▪ Electric vehicle manufacturer Northern Power Grid ▪ Participating DNO The University of Manchester ▪ Network modelling support De Montfort University ▪ Socio- economic modelling support Ricardo ▪ Independent technical verification My Electric Avenue Full Submission Proforma Second Tier funding request: ▪ In kind Contributions from Fleet-drive, Charge your Car and Nissan e.g. subsidised vehicle hire and staff to promote the project **References:** My Electric Avenue closedown report Original Low Carbon Networks Fund submission form My Electric Avenue website

Relevance and timing	**3**	**Assessment:** *The project is ready to roll out when the energy landscape requires the solution* *The project has a reasonable likelihood of being replicated by other DNOs* **Evidence:** The project is dependent on the uptake of electric vehicles. The technology is now at a point where refinements to switching logic, integration with charging points and communications capabilities should allow it to make the final step into BAU and become commercially and operationally viable. Use of electricity due to adoption of electric vehicles is recognised as being an area of uncertainty in SSE and other DNOs RIIO ED1 business plans. The project trialled and proved an alternative solution to traditional reinforcement, utilising Demand Side Response (DSR) to manage uptake of clusters of EVs on GB's electricity networks. Managed EV charging is likely to be a solution adopted by all DNOs as required in the future. The Transform Model was used to project the required network expenditure to 2050. **References:** My Electric Avenue Close down report SSE RIIO-ED1 Business Plan, How we put this Plan together and a summary of the contents, March 2014 Update
Effective project methodology, and effectiveness of implementation	**5**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and the variance was <10%* **Evidence:** All the project SDRCs were met. There was an underspend of £80k due to a combination of realised efficiencies, good project and risk management and increased in-kind contributions from EA Technology, Fleetdrive Electric and Nissan. **References:** My Electric Avenue Close down report

Low Carbon London

Project Title	Low Carbon London
Tier	**Tier 2**
DNO	**UK Power Networks**
Status	**Complete**
LCNF project funding	**£21.7m**
Project objectives	Low Carbon London developed a new approach to distribution network management to meet growing demand from emerging low carbon technologies such as electric vehicles, heat pumps and distributed generation. It focused on carbon reduction and the need to reduce dependency on conventional reinforcement. **Commercial solution:** included multipartite contracts between EDF Energy Networks, National Grid, aggregators, suppliers, and industrial & commercial customers; energy efficiency consultation; contracts with distributed generation for network support; and Time of Use tariffs to support residential and SME peak demand management. **Technical solution:** included an active network management system with half hourly inputs from at least 5,000 smart meters, marshalled through a head end solution; and an operational data store (with complex event processing integrated with an existing network management system).

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	5	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits are quantified in terms of enabling the connection of LCTs.* **Evidence:** LCL successfully demonstrated the use of a number of technical and commercial mechanisms (See objectives above) that will defer reinforcement costs for the connection of LCTs. Carbon benefits were assessed directly as part of the LCL project at a 'per intervention' level. The revised NPV estimate of carbon benefits is £8.6bn, a reduction from the original estimate of £25.8bn, reflecting a reduced contribution anticipated from Heat Pumps, a fall in DECC's estimate of carbon abatement costs, and most significantly a fall in the underlying forecast of grid carbon intensity. **References:** ▪ LCL project closedown report; March 2015.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is highly likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment).* **Evidence:** The main financial benefits of the project are associated with deferring or avoiding network reinforcement through the application of Industrial and Commercial (I&C) demand side response. **References:** ▪ LCL project closedown report; March 2015.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** The project replication section of the closedown report discusses each of the methods tested and specific reports containing further information are published. All reports are detailed in section 13. There are 27 documents including methodology and learning documents; strategy and recommendation documents, etc. All of these documents are available for download from the LCL website. Replication of the exact trials undertaken is noted as being difficult due to the fast changing nature of some of the equipment used, and it becoming obsolete during the timescale of the project. Section 12 of the closedown report details learning dissemination. Various dissemination events have been held both within UKPN and at events for external stakeholders, such as roadshows for other DNOs, various conferences. A comprehensive web portal is also available. Documentation has been peer reviewed by NPG. **References:** ▪ LCL project closedown report; March 2015 ▪ http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/

Involvement of other partners and external funding	**5**	**Assessment:** The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable External funding for > 10% of the project was obtained. **Evidence:** The partners ranged from key London government agencies such as Transport for London and the Office of the Mayor of London (which also incorporated the previous London Development Agency), alongside partners such as National Grid, electricity demand aggregators (EDF Energy, Flexitricity and EnerNOC), Smarter Grid Solutions, CGI, EDF Energy, Siemens, the Institute for Sustainability and the world-recognised Imperial College as the project's academic partner. External funding of £6.6m was contributed against the total funding of £28.3m (~23%). **References:** ▪ LCL project closedown report; March 2015.
Relevance and timing	**3**	**Assessment:** *The project is ready to roll out when the energy landscape requires the solution* *The project has a reasonable likelihood of being replicated by other DNOs* *UKPN has included some elements of the project in their business plan, it is not clear whether other DNOs have included findings in BAU.* **Evidence:** The learning derived on I&C DSR has been used in the UKPN ED1 business plan. UKPN have stated that the work carried out on industrial and commercial Demand-Side Response (DSR) is moving into business as usual and will form part of their Regulatory Reporting Pack submission. A design standard for DSR has been drafted which relies on the results reported in Low Carbon London report A4. The first of what is expected to be several DSR schemes has been contracted. It is not known if other DNOs have utilised this learning in developing their ED1 business plans. Other methods from the project are awaiting the correct energy landscape to be widely implemented. For example the uptake in Electric Vehicles continues to lag behind the 2010 original bid estimates and the updated business case published in the close-down report. The updated business case expected an uptake of 155,000 across the LPN region by now, whereas the total GB uptake remains below 100,000. At this stage, there is no reason to imagine that this is not simply a "delayed start". **References:** ▪ LCL project closedown report; March 2015. ▪ LCL report A4 Industrial and Commercial Demand Response for outage management and as an alternative to network reinforcement ▪ UKPN Business plan (2015 to 2023), Executive summary, March 2014 ▪ UKPN Questionnaire response

Effective project methodology, and effectiveness of implementation	**4**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and there was no overspend >10%, however the variance was >10%.* **Evidence:** Section 5 of the closedown report outlines how SDRC have been achieved and, where relevant, cites the relevant reports. The project has underspent by £4.837m (17%). **References:** ▪ LCL project closedown report; March 2015.

Vulnerable Customers and Energy Efficiency (VCEE)

Project Title	**Vulnerable Customers and Energy Efficiency (VCEE)**
Tier	**2**
DNO	**UKPN**
Status	**Underway**
LCNF project funding	**£3,322k**
Project objectives	The project aims to understand: ▪ The extent to which this vulnerable customers are able and willing to engage in energy efficiency and an 'off peak' tariff. ▪ The benefits that they can realise from their change of behaviour in household energy management. ▪ The challenges and best approaches to engaging with these groups of customers to achieve these aims. ▪ How their move and reduction in demand away from network peak periods may benefit the electricity network and whether it can defer or avoid network reinforcement.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project facilitates deferral of asset reinforcement.* *The carbon benefits are credible and quantified.* **Evidence:** The VCEE project focuses on the fuel poor and vulnerable. It looks at engaging and involving these customer groups in the low carbon economy whilst ensuring their protection; Investigating the extent to which any energy saving or shifting realised by these groups can support/influence network reinforcement planning; Testing the impact of introducing relatively simple technologies on the energy consumption and usage pattern of this group; and Investigating the effect of static time-of-use tariffs on the consumption behaviour of this group. The project is therefore not specifically facilitating the connection of low carbon generation or demand, but has potential to facilitate other carbon benefits, such as deferring asset reinforcement. The full submission pro-forma states: "The VCEE project will deliver 93.51 tCO_2 emission savings by 2017, on average 0.11 tCO_2 emissions per customer. Scaling this up to the 4.5 million fuel poor in the UK, of which a significant number are also vulnerable in some way, emission savings could equate to 153,017 tCO_2". **References:** ▪ VCEE full submission pro-forma and VCEE bi-annual report; Dec-15.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is highly likely to deliver financial benefits in the long term (ED2 and beyond) to selected group of customers.* **Evidence:** Fuel poor / vulnerable households have the potential to benefit from smart metering solutions (smart meter and smart energy display) and from energy efficiency technologies such as energy efficient light bulbs, an ecoKettle and standby saver. The full submission pro-forma states that 'VCEE customers are predicted a £38 to £61 annual bill saving, the latter possible in the most highly engaging households.' **References:** ▪ VCEE full submission pro-forma. ▪ VCEE bi-annual report; Dec-15.
Generates knowledge that can be shared amongst all DNOs	**-**	**Assessment:** *Project incomplete; not marked.* **Evidence:** The project is underway. Dissemination has been occurring in the form of reports, such as the SDRC 9.2 – Customer Recruitment report, as well as at conferences, such as the LCNI conference **References:** ▪ VCEE bi-annual report; Dec-15. ▪ VCEE SDRC 9.2 – Customer Recruitment report; Jun-15.
Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable.* *External funding for > 10% of the project was obtained.* **Evidence:** Partners involved include: British Gas, CAG Consultants, University College London (Energy Institute), Tower Hamlets Homes, Poplar HARCA, Bromley-by-Bow Community Centre and the Institute for Sustainability, National Energy Action, British Red Cross (Critical Friend) and Consumer Futures (Critical Friend). Roles include modelling, customer engagement, installations, energy efficiency, etc. Full submission pro-forma shows external funding of £1,244k (22.7% of total project cost cited). **References:** ▪ VCEE full submission pro-forma. ▪ Summary of the LCNF funds learning EATL, April 2016

Relevance and timing	-	**Assessment:** *Project incomplete; not marked.* **Evidence:** The VCEE project trials have been designed to be timely in delivered learning. Any earlier and the smart meters would not have the required key prepayment services that the fuel poor customer group predominantly uses. Any later and it would be too late by stakeholders to use the project findings during the smart meter rollout. **References:** ▪ VCEE full submission pro-forma.
Effective project methodology, and effectiveness of implementation	-	**Assessment:** *Project incomplete; not marked.* **Evidence:** The latest six-monthly report (Dec-15) shows that SDRC 9.1 to 9.4 are complete, with the remaining two (with completion dates in 2017) being in progress. The report does not contain an update on project costs. **References:** ▪ VCEE bi-annual report; Dec-15.

Solent Achieving Value from Efficiency (SAVE)

Project Title	**Solent Achieving Value from Efficiency (SAVE)**
Tier	**2**
DNO	**SSEPD**
Status	**Underway**
LCNF project funding	**£8,293k**
Project objectives	The project aims to establish to what extent energy efficiency measures can be considered as a cost effective, predictable and sustainable tool for managing demand on electrical networks as an alternative to traditional reinforcement.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	3	**Assessment:** *By looking at energy efficiency the project clearly facilitates the deferral of asset reinforcement. The carbon benefits not specifically quantified.* **Evidence:** The SAVE project looks to compare the impacts of four energy efficiency measures (LED installation; data-informed engagement campaign, DNO price signals direct to customers plus data-informed engagement and community coaching). Overall, the project aims to establish to what extent energy efficiency measures can be considered as a cost effective, predictable and sustainable tool for managing demand on electrical networks as an alternative to traditional reinforcement. The full submission pro-forma suggests the SAVE project will provide SEPD will an opportunity to examine the role a DNO can play in facilitating cost and CO_2 savings targets. However, CO_2 savings from the project are not specifically quantified. **References:** ▪ SAVE progress report; June 2015. &Summary of the LCNF funds learning EATL, April 2016 & SAVE full submission pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is highly likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment).* **Evidence:** The project will have financial benefits for customers in terms of reduced energy use from energy efficiency measures and behaviour change. Potential to benefit large number of customers, but unclear as to whether these benefits would be short or longer-term (project will look to distinguish this). Appears that, at the least, short term benefits would be achieved for the majority of customers. **References:** ▪ SAVE full submission pro-forma.
Generates knowledge that can be shared amongst all DNOs	**-**	**Assessment:** *Project incomplete not marked.* **Evidence:** Section 6.3 of the June 2015 progress report details dissemination activities carried out to date. This includes presentation of the project at a number of events. **References:** ▪ SAVE progress report; June 2015.
Involvement of other partners and external funding	**4**	**Assessment:** *The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.* **Evidence:** Project partners listed as: Future Solent (provider of local contacts and data); University of Southampton (data analysis and model preparation); DNV KEMA (international learning, project methodology, trials managers and learning); Wireless Maingate (international learning and technology providers). Project supporters are: University of Winchester (engagement media); Neighbourhood Economics (community coaching). There are also three project supporters cited: Partnership for Urban South Hampshire (PUSH), Hampshire Chamber of Commerce and SmartGridGB. External funding of £694k listed in the full submission pro-forma. This is 6.7% of the total project cost cited in the document. **References:** SAVE full submission pro-forma.

Relevance and timing	**-**	**Assessment:** *Project incomplete not marked.* **Evidence:** The full submission pro-forma states that the project will incorporate findings from other project but seeks to go further in turning this learning into a tool that will drive BAU behaviour. To make 'energy efficiency led by consumer engagement' a BAU approach for DNOs, the network investment tool must be statistically valid for all network areas. **References:** SAVE full submission pro-forma.
Effective project methodology, and effectiveness of implementation	**-**	**Assessment:** *Project incomplete not marked. - However, the latest progress report shows that the project is on track to achieve its successful delivery reward criteria (SDRC).* **Evidence:** While the project is incomplete, the June 2015 progress report shows that the project is on track to achieve its successful delivery reward criteria (SDRC) – with seven having already been met and the remaining two on target. Section 8 of the budget shows expenditure to date, but does not forecast expected expenditure to project conclusion, so it is not possible to estimate whether the variance will be <10%. **References:** SAVE progress report; June 2015.

D.7 Asset Rating

Flexible Networks for a Low Carbon Future (FNLCF)

Project Title	Flexible Networks for a Low Carbon Future (FNLCF)
Tier	2
DNO	SP Energy Networks (SPEN)
Status	Complete
LCNF project funding	£3,600k
Project objectives	Flexible Networks for a Low Carbon Future aimed to provide network operators with economic, DNO-led solutions to increase and enhance the capability of the networks. These would be capable of being quickly implemented and help to ensure that the networks do not impede the transition to a low carbon future. Learning outcomes from Flexible Networks would inform intelligent future network change management.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits not specifically quantified.* **Evidence:** Flexible Networks aimed to provide a 20% increase in network capacity through a number of innovative measures. This will enable more customers to make the transition to new low carbon generation and demand technologies. Flexible Networks has achieved a 20% increase in capacity for St Andrews and Whitchurch trial sites and facilitated more than 20% additional PV generation onto the Wrexham trial site. The full submission pro-forma cites CO2 savings – 8,200 tCO2 for the Wrexham site. Achieved carbon benefits are not specifically quantified at the end of the project – or in the closedown report **References:** ▪ FNLCF project closedown report; Dec-15. ▪ Summary of the LCNF funds learning EATL, April 2016. ▪ FNLCF; Full Submission Pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Evidence that the project is highly likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment).* **Evidence:** A number of benefits for customers were highlighted through the closedown report: ▪ Next generation telecontrol equipment was developed and successfully deployed in the St Andrews area, which will benefit customers through both reduced supply interruptions and reduced fault restoration times. ▪ Outcomes from the energy efficiency trial interventions provided some degree of peak load reduction and customer annual energy savings. The voltage optimisation estimated that a 1% reduction in voltage can typically lead to a 1% reduction in energy consumption. ▪ The creation of 20% capacity headroom on the trial networks is cited as leading to net benefits for customers. Net financial benefits to customers are therefore expected to be more in the short term associated with deferred reinforcement. **References:** • FNLCF project closedown report; Dec-15.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** The project replication section of the closedown report discusses each of the methods tested and provides links to specific reports containing further information. All the project reports are detailed in section 13.2. There are a large number of technical documents including methodology and learning documents; installation, setup and removal documents; good practice guides; strategy and recommendation documents, etc. A number of these documents are available for download from SPEN's website. Section 12 of the closedown report details learning dissemination. Presentations have been held at LCNF/LCNI conferences and other conferences. A PNDC Stakeholder dissemination event was held in October 2013. Other DNOs have pier reviewed the closedown and other reports and information has been provided to other DNOs on learning outcomes. A dissemination event was held in October 2015. **References:** ▪ FNLCF project closedown report; Dec-15. ▪ http://www.spenergynetworks.co.uk/pages/flexible_networks_for_a_low_carbon_future.asp

Involvement of other partners and external funding	**4**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable. External funding for <10% of the project was obtained.* **Evidence:** Partners: University of Strathclyde (strategic technical direction, learning and dissemination expertise, development of expert analysis tools and software), TNEI (analysis and interpretation of the network monitoring data, development of improved software modelling), Nortech (provision of iHost platform for monitoring, development of `smart' monitors) and BRE (site surveys, online survey). External funding of £174k listed in the full submission pro-forma (~3% total costs). DNO funding £2588k **References:** ▪ FNLCF; Full Submission Pro-forma. ▪ FNLCF project closedown report; Dec-15.
Relevance and timing	**5**	**Assessment:** *The project has been rolled out into BAU.* *Other DNOs are using the learning and techniques.* **Evidence:** The closedown report states: A number of the elements of the project have already been adopted into the ED1 proposals and activities and learning from the project are already being transferred in to BAU to become future standard policy: ▪ Dynamic thermal rating – 10 Primary transformers are planned to have enhanced thermal ratings instead of traditional reinforcement; ▪ Flexible network control – 3600 monitoring devices are planned for deployment; ▪ Voltage optimisation – 2 sites have modified voltage settings to date. During the period 2015-2023, Flexible Networks techniques and tools will be available to use as an alternative to existing practices for suitable network situations. Techniques have been fed into ARC. **References:** ▪ FNLCF project closedown report; Dec-15. ▪ Questionnaire response

Effective project methodology, and effectiveness of implementation	**5**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and the variance was <10%* **Evidence:** Section 5 of the closedown report outlines how SDRC have been achieved and, where relevant, cites the relevant reports. The original budget was £6,279k. A change was requested in 2014 to reduce the LCNF contribution from £3,600k to £2,851k and the total revised budget was £5,284k, with final costs of £5,218. These final costs were 99% of the revised budget, but 83% of the original budget. **References:** ▪ FNLCF project closedown report; Dec-15. ▪ Ofgem decision letter Low Carbon Networks Fund – amendments to Flexible Networks for a Low Carbon Future Project 27 October 2014

D.8 Storage

SoLa BRISTOL

Project Title	SoLa BRISTOL
Tier	**2**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£2.204m**
Project objectives	**"B.R.I.S.T.O.L." was the Buildings, Renewables and Integrated Storage, with Tariffs to Overcome network Limitations project.** SoLa Bristol investigated the combination of home energy storage coupled with new variable tariffs and integrated network control.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits not specifically quantified.* **Evidence:** One of the main project objectives was to 'test the viability of integrating Low Carbon Technologies (LCTs) in a cost effective manner within the context of the Distribution Network'. There are also objectives around smarter grid technologies and use of DC to encourage customer energy efficiency. The LCNF Full Submission Pro-forma stated that it has been estimated that BRISTOL could displace 1,452.3 thousand tonnes of CO_2 by connecting PV generation that would not be connected using conventional network reinforcement methods between 2015 and 2030. This is also stated in the Summary of the LCNF funds learning EATL report. However, actual, achieved carbon benefits are not specifically quantified at the end of the project – either in the closedown report or the final report. **References:** ▪ SoLa BRISTOL project closedown report, 16th April 2016. ▪ Summary of the LCNF funds learning EATL, April 2016. ▪ Low Carbon Networks Fund; Full Submission Pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project may deliver short-term financial benefits to a limited group of customers.* **Evidence:** Conclusions: ▪ Customers can make savings from the use of storage and solar panels. However, given the variability of savings it is difficult to say what the normal saving for a customer would be. ▪ There is some evidence that Time of Use tariffs work in that there were some engaged customers who did modify behaviour to reduce their bills. **References:** ▪ SoLa BRISTOL project closedown report, 16^{th} April 2016.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / stakeholder aspects as applicable.* *Learning was disseminated with stakeholders at a number of events.* **Evidence:** There is a section in the final report on system design and approvals. This is supported by a detailed design report, 'Confirmation of the SoLa BRISTOL design'. This report covers project specific descriptions, component information and supplementary information. However, these are mainly technical in nature and do not specifically cover commercial or stakeholder aspects. A separate customer engagement plan exists for the project. The closedown report states that a workshop was held with other DNOs in September 2015 to share results and thinking from the project. Since completion of the project, two events have been attended where findings of the project have been shared with stakeholders – London Grid & Storage Event (15^{th} March 2016) and Energy UK storage summit (28^{th} April 2016). Due to the findings of the project, it appears that a dedicated project closedown event would not have been appropriate. **References:** ▪ SoLa BRISTOL project closedown report, 16^{th} April 2016. & SoLa BRISTOL final report, January 2016, re-issues 10^{th} March 2016 & Confirmation of the SoLa BRISTOL design report, September 2012. & SoLa BRISTOL Customer Engagement Plan, 18^{th} December 2013.

Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable.* *External funding for > 10% of the project was obtained.* **Evidence:** Partners listed in the full submission pro-forma and EATL report are Siemens, the University of Bath (working with RWE npower as a supplier), Bristol City Council and Moixa Energy. ▪ Siemens have contributed to solution design and appear to have been involved in equipment provision. ▪ The University of Bath have been involved in solution design, data collection and customer engagement. ▪ Bristol City Council have been involved in customer engagement. ▪ Moixa Energy appear to have been involved with the energy storage system. The project therefore is considered to have involved a wide range of external partners covering different project elements. The full submission pro-forma states that the 'Bristol Project requires an investment of £2.20m from the LCNF, the total project costs are £2.78m'. External funding is therefore approximately 26% of total costs. **References:** ▪ SoLa BRISTOL project closedown report, 16th April 2016. &Low Carbon Networks Fund; Full Submission Pro-forma & Summary of the LCNF funds learning EATL, April 2016.
Relevance and timing	**1**	**Assessment:** *The project is ready to roll out when the energy landscape requires the solution.* *The project has potential for replication in niche situations.* **Evidence:** A project conclusion was that SoLa Bristol does not afford DNOs with an immediate or medium term opportunity to modify their distribution systems and that there is no future implementation potential for the method under trial as it currently stands. The benefits are small for DNOs compared to implementation costs. However, there may be a business case for implementation by housebuilders, Energy Suppliers or Building Management companies. To change the case for DNOs, more batteries would need to be installed, but this is not justifiable given the current price of batteries. Method could be revised once market for energy storage has more fully matured. **References:** ▪ SoLa BRISTOL project closedown report, 16th April 2016.

Effective project methodology, and effectiveness of implementation	**3**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) but has an overspend of > 10%.* **Evidence:** The SDRC criteria, proposed evidence and completion status are provided in section 6 of the closedown report. Links are provided to relevant documents. Costs are outlined in section 8 of the closedown report. The report shows overall variance was -4% due to some costs being less than anticipated. However, this takes into account additional budget provided by WPD, due to project overspend. The final spend on the project is approximately 26% over the original budget. **References:** ▪ SoLa BRISTOL project closedown report, 16th April 2016. & SoLa BRISTOL overspend letter, dated 19th August 2015 (relating to Sola Bristol budget and compliance with the Low Carbon Networks (LCN) Fund Governance Framework)

Smarter Network Storage (SNS)

Project Title	**Smarter Network Storage (SNS)**
Tier	**2**
DNO	**UKPN**
Status	**Underway**
LCNF project funding	**£13,218k**
Project objectives	This project is trialling how energy storage could be used to defer traditional network reinforcement and evaluating additional benefits that can be gained to maximise the value, and make storage a more cost-effective alternative. In order to achieve these additional benefits, the storage will be used for a range of other system-wide services, to benefit other electricity system participants, and test both the technical and commercial aspects of these applications. The aims are to: ▪ Demonstrate how 6MW / 10MWh of lithium-ion storage can be deployed on the distribution network to support security of supply. ▪ Trial the multi-purpose application of storage for a range of different system benefits to help maximise value, e.g. investment deferral and ancillary services. ▪ Develop a new optimisation and control system and trial the commercial arrangements for shared use of energy storage.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates one of the carbon benefits: Defer asset reinforcement.* *The carbon benefits are credible and quantified.* **Evidence:** The project is trialling how energy storage could be used to defer traditional network reinforcement and evaluating additional benefits that can be gained to maximise the value, and make storage a more cost-effective alternative In the full submission pro-forma, it is estimated that 6MW of storage capacity, as installed in the project, would provide annual CO_2 emissions savings of 1.7k tonnes of CO_2 when fully integrated. **References:** ▪ SNS full submission pro-forma. ▪ SNS website: http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-%28SNS%29/

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *The project is expected to demonstrate benefits to network which are highly likely to be required in the future to benefit storage owning parties and customers.* **Evidence:** As well as deferring network reinforcement, benefits are associated with Triad optimisation, balancing services and the capacity market. **References:** ▪ SNS progress report; Dec 2015. ▪ Summary of the LCNF funds learning EATL, April 2016.
Generates knowledge that can be shared amongst all DNOs	-	**Assessment:** *Project incomplete not marked* *The project website has a range of learning documents and details of events to date* **Evidence:** SMS project website **References:** ▪ Smarter Network Storage learning event March 2014 ▪ Project reports e.g. SDRC 9.7 Successful Demonstrations of Storage Value Streams, SDRC 9.6 SNS 3.12 Analysis of Integrated Energy Storage Contribution to Security of Supply, SDRC 9.5 Electricity Storage in GB: SNS 4.7 Recommendations for regulatory and legal framework
Involvement of other partners and external funding	**4**	**Assessment:** *The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.* **Evidence:** Project Partners: AMT-SYBEX (information and data exchange); Durham University (development of algorithms); Imperial College London (analysing, modelling and optimising electricity systems, core studies and development of recommendations); KiWiPower (provide and manage the route to market); National Grid (guidance and advice); Pöyry Management Consulting (market and regulatory expertise, analytical services); Smartest Energy (market reconciliation and pricing information) and Swanbarton (overall development support and specialist support in commercial arrangements). Project Suppliers: A123 Systems Inc. (supplier of the energy storage device). Project Supporters: UK Energy Research Centre, IMechE, Electricity Storage Network Full submission pro-forma shows external funding of £1,216k (~8% of total project cost cited (£15,292k)). **References:** ▪ SNS full submission pro-forma.

Relevance and timing	-	**Assessment:** *Project incomplete not marked, However the industry has recognised the value of storage to provide flexibility and support system security and hence the SNS trial is providing valuable learning with respect to the demonstration of the benefits of large scale storage.* **Evidence:** The National Infrastructure Commission has highlighted the importance of storage in delivering a more flexible, efficient and cost-effective electricity system , while the DECC/Ofgem chaired Smart Grid Forum confirms the status of storage as one of the key smart interventions likely to be required in the future smart grid. UKPN have stated that the energy storage device at Leighton Buzzard is their key tool for managing demand at the Leighton Buzzard substation, with conventional reinforcement continuing to be deferred due to the success of the device. Meanwhile, the device is successfully delivering support to National Grid under three different contractual mechanisms and through business as usual contracts. It has supported the TRIAD demand reduction initiative through a business as usual contract with Smartest Energy for large energy consumers. It has supported the National Grid Short Term Operating Reserve (STOR) programme through the aggregator KiWi Power. It has supported National Grid's frequency response requirements through a bilateral agreement in which KiWi Power has acted as agent. **References:** SDRC 9.7 Successful Demonstrations of Storage Value Streams
Effective project methodology, and effectiveness of implementation	-	**Assessment:** *Project incomplete not marked, however the project has achieved all its successful delivery reward criteria (SDRC) to date.* **Evidence:** The latest 6 monthly progress report shows the completed SDRCs have been delivered on time and the project is on track for the remaining deliverables. Financial information and progress against budget is not publically available. **References:** Smarter Network Storage, Progress Report, Dec 2015.

D.9 Network Configuration

Low Energy Automated Networks (LEAN)

Project Title	**Low Energy Automated Networks (LEAN)**
Tier	**2**
DNO	**Southern Electric Power Distribution plc. (SEPD)**
Status	**New**
LCNF project funding	**£2,670k**
Project objectives	LEAN seeks to demonstrate new methods that can be applied to existing assets to reduce losses in the shorter term. The principal method for the LEAN project involves the use of a Transformer Auto Stop Start mechanism. SEPD will deploy a second method, Alternative Network Topology, where appropriate. LEAN builds on learning captured from SEPD's previous LCNF Tier 1 and IFI projects.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates a reduction in losses.* *The carbon benefits are credible and quantified.* **Evidence:** LEAN will directly reduce electrical losses and associated carbon emissions. If the LEAN solution is proven, it will help DNOs to manage the effects that distributed generation connection and other low carbon technologies will have on the network. Early analysis extrapolated across GB indicates that the methods will deliver a reduction in annual network losses of up to 31,838MWh, which is equivalent to 6,421 tonnes of CO_2. **References:** ▪ LEAN full submission pro-forma.
Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *The project could deliver a modest financial benefit at primary substation sites.* **Evidence:** The financial benefit will be based on the saving associated with the cost of losses. **References:** ▪ LEAN full submission pro-forma.

Generates knowledge that can be shared amongst all DNOs	-	*Project incomplete not marked*
Involvement of other partners and external funding	-	**Assessment:** *The project did not involve any external partners. However, these are expected to be engaged as the project begins.* **Evidence:** The full submission proforma indicates that SEPD has engaged with a number of potential suppliers, but no information is provided on either suppliers or partners. No external funding is cited in the full submission proforma. **References:** ▪ LEAN full submission pro-forma.
Relevance and timing		*Project incomplete not marked*
Effective project methodology, and effectiveness of implementation		*Project incomplete not marked*

Flexible Urban Networks Low Voltage (FUNLV)

Project Title	**Flexible Urban Networks Low Voltage (FUNLV)**
Tier	**2**
DNO	**UKPN**
Status	**Underway**
LCNF project funding	**£6,528k**
Project objectives	The three core objectives of the project are to: 1. Optimise capacity on the low voltage network closest to customers to accommodate the forecasted growth LCTs on existing connections by making the network more flexible and resilient through capacity sharing between substations. 2. Improve connection offers (time & cost) in urban areas by knowing where best to connect, and by managing voltage, power flows and fault current through the use of power electronics. 3. Advance the future network architecture debate for the sector through the evaluation and dissemination of financial learning, benefits and architecture of the power electronics applications on different network architectures and by providing network configuration control in combination with remote switching.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	5	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits are credible and quantified.* **Evidence:** The overarching aim of this project is to explore how the use of power electronics can defer reinforcement and facilitate the connection of low carbon technologies and distributed generation in urban areas, by meshing existing networks which are not meshed, and by breaking down boundaries within existing meshed networks. FUN-LV will facilitate the connection of low carbon technologies, particularly in dense urban areas where it might otherwise be difficult to carry out traditional reinforcement. It is estimated that 10.1 MW of capacity could be released at the project scale; based on an equal use of Method 1-3 solutions across 36 trial sites. This could facilitate the connection of around 850 heat pumps and 1,050 EVs, resulting in carbon emissions savings of 3,400 tonnes at project level. **References:** ▪ FUNLV full submission pro-forma. And FUNLV website: http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Flexible-Urban-Networks-Low-Voltage/

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Expectation that the project is highly likely to deliver financial benefits to some customers in urban areas, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment)* **Evidence:** The benefits are associated with the deferral or reduction in the need for traditional reinforcement solutions. **References:** ▪ FUNLV progress report; Dec 2015. ▪ Summary of the LCNF funds learning EATL, April 2016.
Generates knowledge that can be shared amongst all DNOs	-	• *Project* incomplete *not marked*
Involvement of other partners and external funding	**4**	**Assessment:** *The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.* **Evidence:** **Project Partners**: IGE Digital Energy (shadow control system), IC Consultants Ltd (algorithms for the power electronics control system), PPA Energy (Network Awareness and Process Improvement) and CGI UK Ltd (project IT and data-set creation and management). **Project Suppliers**: GE Power Conversion, EA Technology Ltd (providing LV circuit breakers), Turbo Power Systems (suppliers of the power electronic units). Full submission pro-forma shows external funding of £518k (5.8% of total project cost cited (£8,867k)). **References:** ▪ FUN-LV full submission pro-forma.
Relevance and timing	-	*Project incomplete not marked*
Effective project methodology, and effectiveness of implementation	-	*Project incomplete not marked*

D.10 Visibility

LV network templates

Project Title	LV network templates
Tier	**2**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£7,847,579**
Project objectives	The primary objective of the LV Network Template Project was to establish a set of novel “templates” that would accurately estimate different cluster types of load and associated voltage profiles at a given substation without the need for costly monitoring. There were four secondary objectives.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	5	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits are credible and quantified.* **Evidence:** The project drivers were to reduce need for network reinforcement and facilitate connection of low carbon devices at reduced cost. One of the project SDRC criteria was to determine the effects of stresses on the network from local low-carbon installations and identify significant, relevant findings. DNOs were to be provided with analysis and WPD commentary on application of output to network management in response to low carbon stresses and benefits. ‘Stresses on the LV Network caused by low carbon technologies’ report published. It is estimated (in the closedown report) that the project would save 41,000 tonnes a year of CO_2. **References:** ▪ LV Network Templates; Project closedown report. ▪ Summary of the LCNF funds learning EATL, April 2016. ▪ LV Network Templates; Full submission pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to the majority of customers.* **Evidence:** The closedown report highlights a reduction in customer energy bills from the South Wales selective voltage reduction deployment. **References:** ▪ LV Network Templates; Project closedown report. ▪ Summary of the LCNF funds learning EATL, April 2016.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** The project replication section of the closedown report gives a good level of detail relating to physical components or knowledge requirements; Appendix A of the closedown report considers knowledge management which is complementary to the project's various engineering reports which allow the LV Templates process to be understood and replicated. Network templates data is published in Appendix C of the closedown report. An email is provided for obtaining further information and the lv network templates classification tool is provided on request. A large number of dissemination methods and events were use/held including websites, press releases. Industry conferences and seminars, industry reports, a public engagement company, workshops and direct DNO engagement (particularly at the final stages of the project). Techniques from the project are being used by SPEN ARC. **References:** ▪ LV Network Templates; Project closedown report., main document, Appendix A and Appendix C ▪ Stresses on the LV network from low carbon installations ▪ Use of proxy PV FiT meters to reflect local area Generation ▪ Demonstration of LV Network Templates through statistical analysis

Involvement of other partners and external funding	**4**	**Assessment:** *The project involved some external partners covering some of the main technical /commercial / stakeholder aspects as applicable.* **Evidence:** Partners involved in the project, as listed in Table 1 of the closedown report, were Welsh Assembly Government, the University of Bath, Accenture, NPower, GE, Passiv Systems, EDMI Meters and all DNOs. The roles of project partners are clearly outlined in Table 1 and cover diverse roles including: data provision and management, advisory support, customer engagement, equipment provision and monitoring. External funding of £56,000 noted in full submission proforma. This is 0.6% of total project cost. **References:** ▪ LV Network Templates; Project closedown report. ▪ LV Network Templates; Full submission pro-forma.
Relevance and timing	**5**	**Assessment:** *The project has been / is ready to roll out into BAU.* *Other DNOs have included the project in their business plans.* **Evidence:** The project closedown report provides good detail on planned implementation, with a number of elements already deployed and others planned. WPD have been able to successfully develop templates that can with an 82.2% level of accuracy estimate the load and voltage flows at a given LV substation without the need for costly monitoring. This is being rolled out as part the normal planning tool set. PV Diversity factors have been updated to reflect the outputs of LVNT. WPD have deployed voltage reduction in South Wales, resulting in savings to customers. This is being rolled out across the business at selected substations. Some areas are noted as requiring further work. Techniques from the project are being used by SPEN ARC. **References:** ▪ LV Network Templates; Project closedown report. ▪ WPD Questionnaire response
Effective project methodology, and effectiveness of implementation	**5**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and the variance was <10%.* **Evidence:** The project has achieved all of its SDRC, and comment has been provided against each. The total variance in project costs was 6.2%. **References:** ▪ LV Network Templates; Project closedown report.

Street Smart (ETA)

Project Title	Street Smart (ETA)
Tier	**2**
DNO	**Electricity North West**
Status	**Underway**
LCNF project funding	**£8,438k**
Project objectives	By combining innovative technology with existing assets, Smart Street aims to make networks and customers' appliances perform more efficiently and make it easier to adopt low carbon technologies onto the electricity network such as solar panels, electric vehicles and heat pumps. It builds on the learning from Electricity North West's two previous LCN Fund projects – Capacity to Customers and CLASS.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**5**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits are credible and quantified.* **Evidence:** The full submission proforma states that the eta Project accelerates the reform of the electricity networks in two ways: firstly, it facilitates the quick connection of low carbon generation and demand; and secondly the new voltage regulation regimes in eta will demonstrate how distribution networks can help reduce the energy bills of customers. The methods trialled are expected to help in quick delivery of capacity, which will prevent delays in the connection of low carbon generation and demand to the network. The potential carbon savings and clearly outlined in the full submission proforma. Overall, it is stated that, assuming equal demand and generation led reinforcements, Electricity North West could save 370 000 tCO_2e of asset carbon if eta is deployed across its network. **References:** ▪ ETA full submission pro-forma.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Likely that the project is highly likely to deliver short term financial benefits to the majority of customers due to deferring reinforcement. May produce long term benefit if reinforcement can be avoided.* **Evidence:** The financial benefits of the project are in respect of facilitating connection of LV LCTs (generation and demand), especially in alleviating problems caused by LCT clustering. It does this by deferring or avoiding traditional reinforcement **References:** ▪ ETA full submission pro-forma ▪ ETA progress report; Dec 2015. ▪ Summary of the LCNF funds learning EATL, April 2016.
Generates knowledge that can be shared amongst all DNOs		Not assessed – project ongoing
Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable.* *External funding for > 10% of the project was obtained.* **Evidence:** Project partners are: Kelvatek (Low Voltage circuit breakers, link box switches and dissemination); Siemens UK Ltd (optimisation software and dissemination) and Impact Research (customer engagement and survey activities and dissemination). There are also a range of project supporters: TNEI (technical support); University of Manchester (data analysis, modelling and dissemination); Queen's University Belfast (data analysis, modelling and dissemination); Tyndall Manchester Climate Change Research (carbon impact assessment); Institution of Engineering and Technology (expert technical community consultation); Wigan and Leigh Housing Association (Registered Social Landlord) and Greater Manchester Combined Authority. Full submission pro-forma shows external funding of £1,926k (16.8% of total project cost cited (£11,476k)). **References:** ▪ ETA full submission pro-forma.
Relevance and timing		Not assessed – project ongoing
Effective project methodology, and effectiveness of implementation		Not assessed – project ongoing

New Thames Valley Vision (NTVV)

Project Title	**New Thames Valley Vision (NTVV)**
Tier	**2**
DNO	**SSE**
Status	**Underway**
LCNF project funding	**£22,819k**
Project objectives	NTVV will use data intelligently to identify and predict network stress points to enable more informed decisions. NTVV will evaluate: ▪ a new network and planning environment; ▪ industrial and commercial (I&C) and small and medium sized enterprises (SME) automated demand side response; ▪ low voltage (LV) static voltage control; ▪ street level energy storage; and ▪ a range of communications solutions. Objectives: 1. Applying data analysis from the Energy Demand Research Project (EDRP) to understand the different customer types connected to the distribution network, and their effect on network demand 2. Understanding how the behaviour of different customer types allows informed network investment decisions to be made 3. Demonstrating mitigation strategies, both technical and commercial, in a live environment, to understand: a. The extent to which DSR can contribute to network flexibility, and identifying which customers are most likely to be early and effective adopters of DSR b. Where and how power electronics (with and without energy storage) can be used to manage power factor, thermal constraints and voltage to facilitate the connection of renewables on the LV network 4. Undertaking dissemination and scaling activity to ensure validity and relevance to the GB

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**5**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits are credible and quantified.* **Evidence:** It is estimated that the project will deliver 34Mt CO_2 benefits. The benefits are outlined in the full submission proforma as being associated with the connection of PV generators, the connection of electric vehicles, and heat pumps without need for reinforcement. **References:** ▪ NTVV full submission pro-forma.
Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *The project is highly likely to deliver financial benefits to the majority of customers, but these benefits may be comparatively short term (e.g. associated with asset replacement deferment)* **Evidence:** The financial benefits are associated with connection of generation, heat pumps and electric vehicles by deferring and avoiding reinforcement. **References:** NTVV full submission pro-forma.
Generates knowledge that can be shared amongst all DNOs		*Project incomplete not marked*

Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable.* *External funding for > 10% of the project was obtained.* **Evidence:** Partners include: University of Reading (Statistical modelling, analysis and profiling of customer behaviours); GE (Innovative technical integration, enabling project outputs to flow into DNO & third party systems); Honeywell (Provision of demand response solutions to commercial customers via building management); EA Technology (Knowledge dissemination by way of technical policies, procedures and training); KEMA (Learning dissemination, stakeholder engagement and technical validations); Bracknell Forest Council (Support in the integration of local planning with DNO planning and investment). The full submission pro-forma shows external funding of £4,414k (16.2% of total listed (£27,233k)). **References:** ▪ NTVV full submission pro-forma.
Relevance and timing		*Project incomplete not marked*
Effective project methodology, and effectiveness of implementation		*Project incomplete not marked*

D.11 Voltage Control

CLASS

Project Title	CLASS
Tier	2
DNO	ENW
Status	Complete
LCNF Project funding	£7.214m
Project objectives	The CLASS solution is to obtain a demand response and to absorb reactive power by managing existing assets.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates one of the carbon benefits: Provide reactive power services/ provide frequency response service/Defer asset reinforcement.* *The carbon benefits are credible and quantified* **References:** ▪ Class Project Close down report, 30 September 2015, ▪ Summary of the LCNF funds learning EATL, April 2016 ▪ Carbon Impact Assessment final report, September 2105 **Evidence summary:** Benefits linked to low carbon energy sector: ▪ Manage system peak ▪ Defer asset reinforcement ▪ Provide frequency response service ▪ Provide reactive power services Carbon Impact: Carbon benefits associated with provision of demand response and reactive power ancillary services. Noted that when reinforcement is deferred losses increase which if supplied by non low carbon generation has a carbon penalty.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *The financial benefits are short term (associated with asset deferment) but are applicable to the majority of customers* **Evidence summary & References:** Financial benefits detailed in Close down report and summarised in Summary of the LCNF funds learning report: ▪ Associated with deferral of reinforcement of primary substation for up to 3 years. ▪ Applicable on GB wide scale depending on specific substation circumstances.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence summary & References:** CLASS closedown event held 9 Sept 2015, slides available. 2012 – 2016 Seven videos/webinars throughout the project. Closedown report contains link to closedown event slides. Section 10 of the closedown report covers project replication. Section 13.2 of closedown report has references to key learning documents with replication specifically: ▪ CLASS Voltage Regulation Scheme, 27 February 2014 ▪ Commissioning report (MicroTPP relays and autonomous substation controller). April 2014 ▪ ICCP report (Control centre data exchange commissioning), April 2014 ▪ University of Manchester Reports 1-3 (demand profile study, demand response and reactive power absorption capability modelling, transformer health impact study), Jan 2015

Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable* *External funding for > 10% of the project was obtained.* **Evidence:** Wide range of external partners: Impact Research – Customer engagement and analysis Siemens UK Ltd – Substation controller supply National Grid – Control centre data exchange Chiltern Power – Lead the Security and Quality of Supply standards consultation process The University of Manchester – Network modelling and analysis; Voltage profile modelling study; Asset health study (incl. University of Liverpool); Carbon impact assessment The Tyndall Centre for Climate Change – Carbon impact assessment Parsons Brinkerhoff – Selection of primary substations sites; Manage the Security and Quality of Supply standards consultation process General Electric (GE) – Configuration of link between ENWL and NG control rooms Class Full Submission Proforma Second Tier funding request: ▪ LCN Fund: £7.17 million ▪ Electricity North West Contribution: £0.81 million ▪ Project Partners' contribution: £0.91million **References:** Class Close down report Original Low Carbon Networks Fund submission form ENWL – CLASS Class website

Relevance and timing	**4**	**Assessment:** *The project has been /is ready to roll out into BAU.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The solution could be rolled out into BAU – closedown report identifies that there are no technical hurdles to prevent the roll out of CLASS by any DNO. Hence this project is relevant once the energy landscape requires it. Both NPG and SPEN mentioned the CLASS project in their BAU discussions with EA Technology in the LCNF project learning study. The solution will defer local network reinforcement, and how long reinforcement can be deferred depends on how loaded specific assets are and how quickly the local peak demand increases. The solution provides global frequency response (avoiding simultaneous transformer reclosing would need to be considered is taken up as a widespread solution). The area of voltage control as a smart solution is applicable to all networks and has been identified by several DNOs as being of interest, SPEN and NPG specifically mentioned the Class project in a response to EATL during the LCNF project learning project: UKPN, NPG have identified enhanced voltage control as a solution in their innovation business plans **References:** Class Close down report UKPN: Our approach to Innovation Strategy and delivery March 2014 NPG: Our business plan, Annex 1.9, Smart Grid development plan, March 2014
Effective project methodology, and effectiveness of implementation	**4**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and there was no overspend >10%,however the variance was >10%* **Evidence:** Total project variance 11% (underspend) due to project efficiencies All the project SDRCs were met apart from the ongoing final SDRC to continue a ten year data collection and analysis which is being undertaken by ENWL in conjunction with National Grid **References:** Class Close down report

Customer Led Network Revolution (CLNR)

Project Title	Customer Led Network Revolution (CLNR)
Tier	2
DNO	Northern Power Grid (NPG)
Status	Complete
LCNF project funding	£27,353k
Project objectives	Smart grid project designed to test a range of customer-side innovations (innovative tariffs and load control incentives) alone and in combination with network-side technology (including voltage control, real time thermal rating and storage). The project was designed to deliver robust learning that would be applicable to a high percentage of GB networks and demographic groups.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	5	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits are credible and quantified.* **Evidence:** The project set out to deliver cost effective solutions to managing the additional strain that will be placed on electricity distribution networks that will be caused by the transition to a low carbon economy, in particular the change to load and generation patterns due to the forecast growth of LCTs. It has achieved this by delivering learning that quantifies the impact of future load and generation profiles, quantifying the scale and cost of both network flexibility and customer flexibility and providing a decision support tool and a control system that are able to optimise from a range of solutions to provide the most appropriate solutions for deployment to address a range of constraints and, once deployed, operate the solutions in real-time to provide the optimum response based upon real-time network monitoring / modelling. In the final report learning outcome 4 sought to develop the overall optimum solutions to resolve future network constraints which could result from the transition to a low carbon economy. Analysis and modelling was used to draw conclusions on this learning outcome. The final report states: ‘On the assumption that the project learning is adopted nationally (where the learning is replicable), it is estimated that the project will deliver, to consumers over the period 2020 – 2050, a present value (i.e. discounted to 2014 value) of between £5.0bn and £26.0bn of net financial benefits, including value from between 10.8MtCO2 and 32.5MtCO_2 emission savings’.

		References: ▪ CLNR Close down report; Apr-15. ▪ Summary of the LCNF funds learning EATL, April 2016. ▪ CLNR Full submission pro-forma.
Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Compelling evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to the majority of customers.* **Evidence:** The project benefits are associated with modified network planning including LCT customer demand and diversity learning as well as learning about DSR and storage resulting in in capital cost savings direct customer benefits and generation benefits. The project is therefore considered to have a high likelihood of delivering significant financial benefits in the long term. **References:** ▪ CLNR Close down report; Apr-15.

Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist. These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** Section 10 of the closedown report highlights the anticipated business as usual costs to purchase the equipment required in the project. It also sets out relevant lesson learned reports. Various other learning documents have been produced, including policy updates, cost benefit analysis, technical recommendations for purchase, equipment application guides, operational guidance notes, and training materials). These are all available on the CLNR website. There are specific documents that propose changes to industry design policy and guidance documents: CLNR-L185: Review of the distribution network planning and design standards for the future low carbon electricity system; CLNR-L263: A review of Engineering Recommendations P15, P17 and P27 (Transformers, Cables and Overhead Lines); and CLNR-L248: Optimal solutions for smarter distribution systems. Three key learning reports have been produced - CLNR-L246: Developing the smarter grid: the role of domestic and small and medium enterprise customers; CLNR-L247: Developing the smarter grid: the role of industrial and commercial and distributed generation customers; and CLNR-L248: Optimal solutions for smarter distribution systems. Links to key project documents can also be found in section 13 of the closedown report. There have been multiple methods used to communicate and disseminate learning with stakeholders, which are detailed in section 12 of the closedown report. This has included the website, project videos, social media, presentation at events, a mailing list, peer reviewed papers, etc. **References:** ▪ CLNR Close down report; Apr-15. ▪ Lessons learned reports (CLNR-L163, CLNR-L164, CLNR-L165 and CLNR-L167) ▪ http://www.networkrevolution.co.uk/resources/project-library/

Involvement of other partners and external funding	**5**	**Assessment:** *The project involved a wide range of external partners covering the main technical /commercial / stakeholder aspects as applicable.* *External funding for > 10% of the project was obtained.* **Evidence:** The project website clearly sets out the project partners and their role in the project. Partners include: British Gas (customer recruitment and engagement); EA Technology (client engineer – solution design, equipment specification and technical support); Durham Energy Institute (academic process, core hypotheses, analysis and conclusions); the Newcastle Institute for Research on Sustainability (NIReS) at Newcastle University (academic support). Other associates also provided advice and guidance. The full submission pro-forma lists external funding of £22,227k, which is 42% of total project cost cited. **References:** ▪ CLNR Full submission pro-forma. ▪ http://www.networkrevolution.co.uk/the-project/who-was-involved/
Relevance and timing	**4**	**Assessment:** *The project has been /is ready to roll out into BAU. The project has a high likelihood of being replicated by other DNOs.* **Evidence:** From section 3 of the closedown report, the objective of learning outcome 5 was to provide a framework for transition of the technologies and interventions trialled by CLNR into business as usual (BAU). For the outputs for DNOs, include: ▪ The provision of a prototype software tool for network designers (NPADDS); ▪ Material for training courses; ▪ New operational procedures to define safe working practices for new technologies; ▪ Design policy guidance; ▪ Equipment specifications and equipment application documents; and ▪ Recommendations to update national design standards. CLNR has contributed to NPGs ED1 plans with respect to enhanced voltage control on primary and secondary networks, general and LCT load growth solutions and ANM connection of DG. NPGs Smarter Network Engineering Strategy (Appendix 4 of the Smart Grid development plan) draws on the learning from CLNR. **References:** ▪ CLNR Close down report; Apr-15. ▪ NPG Smart Grid development Plan, March 2014 (Annex 1.9 of Business Plan 2015 - 2023) ▪ Questionnaire response

Effective project methodology, and effectiveness of implementation	**5**	**Assessment:** *The project achieved all its successful delivery reward criteria (SDRC) and the variance was <10%.* **Evidence:** Section 5 of the closedown report shows how the project performed against its SDRC and a separate report was produced in May-15 outlining the criteria and performance, including evidence to support this. SDRC have been achieved. Section 7 of the closedown report shows that the original budget was £31.034m and the actual expenditure was £31.045 (so within 0.03%). **References:** ▪ CLNR Close down report; Apr-15. ▪ Successful Delivery Reward Application (CLNR-G027); May-15.

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ANNEX E – TIER 1 PROJECT ASSESSEMENTS

E.1 Introduction

A qualitative assessment has been undertaken of the Tier 1 projects against the following criteria:

1. Accelerates the development of a low carbon energy sector
2. Has the potential to deliver net financial benefits to future and/or existing customers
3. Has a direct Impact on the operation of a DNO's Distribution System
4. Generates knowledge that can be shared amongst all DNOs
5. Focuses on network methods that are at the trialling stage

The criteria were scored on a 1-5 basis and each criteria was weighted. The overall scores can be found in Section 4.2. Note the score range for the first criteria "accelerates the development of a low carbon energy sector" was from 1-4. A descriptor of the scores against the criteria and the weighting is detailed in Section E3.

These criteria are based on the specific Tier 1 project requirements set out in the LCNF governance documents. Whilst it is recognised that some changes were made to specific criteria as the scheme evolved, the criteria above are felt to be a suitable way to assess all the projects.

As for the Tier 2 projects whilst the financial benefits are considered qualitatively they are not scored as they have been separately considered in the quantitative assessment, however the grouping between long term and short term benefits, and the overall beneficiaries identified in against this criteria are pertinent to this evaluation.

Some projects are incomplete or close down report information is not available, these are listed in Table 22 and have not been assessed.

Table 22 – Tier 1 projects that have not been assessed

Project name	DNO	Reason
Hydro Active Network Management	SPEN	Close down report not currently available
Impact of Electrolysers on the Network	SSEPD	Information not currently available
Electric Boulevards	WDP	Information not currently available
ECHO – Energy Control for Household Optimisation	WPD	Ongoing
Smart Building Potential	SPEN	Ongoing as NIA
Smart Urban LV	UKPN	Ongoing
Fault Sense	ENW	Ongoing
Voltage Control System Integration - D-SVC Phase 2	WDP	Ongoing
Power Transformer Real Time Thermal Rating	UKPN	Ongoing as NIA
Combined On-Line Transformer Monitoring	ENW	Ongoing

One project, Seasonal Generation Deployment, was stopped as it proved to be uneconomic for generation owners to deploy units on a seasonal basis at a cost that would be lower than conventional reinforcement.

The remaining 31 projects are grouped using the same categorisation as elsewhere in this report.

E.2 Index

Distributed Generation

- Network Management on the Isles of Scilly.
- 1MW Battery, Shetland.
- Orkney Energy Storage Park.
- Trial of Orkney Energy Storage Park.

Fault Level Management

- 33kV Superconducting Fault Current Limiter.
- Implementation of AFLM Scheme.

Flexible Demand

- Demonstrating the Functionality of Automated Demand Response.
- Trial Evaluation of Domestic Demand Side Management.
- Community Energy Action.

Asset Rating

- Implementation of Real-Time Thermal Ratings.
- Temperature Monitoring Windfarm Cable Circuits.
- Power Transformer Real Time Thermal Rating.

Storage

- Demonstrating the Benefits of Short-Term Discharge Energy Storage on an 11kV Distribution Network.
- LV Network Connected Energy Storage.

Network Configuration

- The 'Bidoyng' Smart Fuse.
- Clyde Gateway.

Visibility

- LV Current Sensor Technology Evaluation.
- Low Voltage Network Solutions.
- Demonstrating the Benefits of Monitoring LV Network with Embedded PV Panels and EV Charging Point.
- Suburban PV Impact .
- Validation of Photovoltaic (PV) Connection Assessment Tool.
- Early Learning of LV Network Impacts from Estate PV Cluster.
- Low Voltage Network Modelling and Analysis Environment.
- Low Voltage Protection and Communications.
- Distribution Network Visibility.
- Ashton Hayes Smart Village.
- Hook Norton Low Carbon Community Smart Grid (Smart Hooky).
- Interconnection of WPD and NGC SCADA.
- Combined on-line Transformer Monitoring.

Voltage Control

- Low Voltage Integrated Automation (LoVIA).
- Voltage Management on LV Busbar.
- Voltage Control System Demonstration Project.
- Digital Substation Platform.

E.3 Tier 1 evaluation criteria

Tier 1 evaluation criteria

Criteria	1a	1b	2	3	4
Weighting	10		5	5	2
Title	Accelerates the development of a low carbon energy sector	Has the potential to deliver net financial benefits to future and/or existing customers	Has a Direct Impact on the operation of a DNO's Distribution System	Generates knowledge that can be shared amongst all DNOs	Focuses on network Methods that are at the trialling stage (TRL 5 to 8)
Score 5 descriptor		Evidence that the project is likely to deliver financial benefits in the long term (ED2 and beyond) to the majority of customers	The project has been / is ready to roll out into BAU or outputs are utilised in later LNCF projects. Other DNOs have included the project in their business plans.	Specific replication report(s) exist / are available on request. A learning dissemination event or webinar was held.	Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment
Score 4 descriptor	The project clearly facilitates the connection of low carbon generation or demand.	Evidence that the project is likely to deliver financial benefits in the long term (ED2 and beyond) to selected group of customers	The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects. The project has a high likelihood of being replicated by other DNOs.	Specific replication report(s) exist / are available on request. There is no evidence of a learning dissemination event or webinar.	Solution moved to TRL8 (complete and qualified by end of trial), or commercial solution developed suitable for roll out
Score 3 descriptor	The project clearly facilitates one of the carbon benefits: Provide reactive power services/ Provide frequency response service/Defer asset reinforcement.	Evidence that the project is likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment)	The project is ready to roll out when the energy landscape requires the solution The project has a reasonable likelihood of being replicated by other DNOs	A learning dissemination event or webinar was held but there are no specific replication reports.	Solution moved to TRL7 (system prototype demonstrated in operational environment), or commercial solution demonstrated in operational environment
Score 2 descriptor	The project just demonstrates carbon benefit with respect to increasing energy efficiency.	Evidence that the project may deliver short-term financial benefits to a limited group of customers (e.g. associated with asset replacement deferment)	The project has been / is ready to roll out into BAU. The project has potential for replication in niche situations.	The only replication information available is in the closedown report.	Solution moved to TRL6 (technology demonstrated in relevant environment), or commercial solution demonstrated in restricted environment
Score 1 descriptor	The project does not clearly demonstrate any carbon benefits.	Little or no evidence that the project will deliver any financial benefit to customers.	The project is ready to roll out when the energy landscape requires the solution. The project has potential for replication in niche situations **OR** This is a one off project with no potential for future replication.	No dissemination or replication documentation is evident.	Solution has not progressed wrt technology level, or has not progressed wrt a commercial arrangement

E.4 Distributed Generation

Network Management on the Isles of Scilly

Project Title	**Network Management on the Isles of Scilly**
Tier	**1**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£1,125,000**
Project objectives	The scope and objectives of the project, as detailed in the original LCNF Tier-1 pro forma, were to: ▪ Establish a real-time monitoring system on all the distribution substations. ▪ Maximise existing generation facilities. ▪ Control the generation using new methods.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits not specifically quantified.* **Evidence:** This project has created a platform to build an understanding of LV loading in weakly connected areas that may be supplied by generation islanded from the main network. Knowledge has been generated to help implement a platform which supports the connection of embedded generation and is able to maximise the effectiveness of any controllable generation. During the project 15 embedded low carbon generators have been connected across the Isles and the installation of the monitoring will allow this to be expanded. The carbon benefits are not specifically quantified. **References:** ▪ Network Management on the Isles of Scilly; Close down report; November 2013.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Indication that the project could deliver financial benefits to the majority of customers in the local area* **Evidence:** Benefits to customers are noted in terms of improved security of supply following a HV fault. While there are likely to be some short-term financial benefits here, the financial benefits to customers are not specifically quantified. However it is noted that the monitoring system will allow the future connection of additional generation onto an electrically weak system, thus providing benefits to the generators and deferring the need for additional submarine cables. **References:** ▪ Network Management on the Isles of Scilly; Close down report; November 2013.
Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** Business as usual changes are cited in section 10.2. The closedown report also notes that the learning from this project can be taken forward and implemented in other applications where dynamic system stability can be a problem, and where frequency deviation might be greater influenced by the number of connected generation sets. Section 13 details planned implementation. LV monitoring will continue to be rolled out to suitable substations. The outcomes of the project have fed into FALCON. **References:** ▪ Network Management on the Isles of Scilly; Close down report; November 2013.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *A learning dissemination event or webinar was held.* **Evidence:** This project has been reported on during both the 2012 and 2013 Low Carbon Network Fund Conferences. The closedown report contains a level of technical detail, and design documents and specifications for the equipment developed for the project are available on request. **References:** ▪ Network Management on the Isles of Scilly; Close down report; November 2013.

Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment.* **Evidence:** TRL in the pro-forma is marked as between 6 and 8. All objectives and success criteria for the project were met, as detailed in section 9 of the closedown report. A system is in place across the Isles. The learning from the project is also being used in FALCON. The solution is therefore considered to be at TRL9. **References:** ▪ Network Management on the Isles of Scilly; Close down report; November 2013. ▪ Tier 1 pro-forma

1MW Battery, Shetland

Project Title	1MW Battery, Shetland
Tier	**1**
DNO	**SSE**
Status	**Complete**
LCNF project funding	**£1 million**
Project objectives	This Tier 1 project looked to secure initial learning from the installation and operation of the battery and integration with local demand side response to remove power station peaks providing additional demand capacity (in a similar way to managing a network load constraint).

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits not specifically quantified.* **Evidence:** One of the success criteria for the project was that the battery must be able to reduce the peak demand on the power station allowing the connection of new demand (in a similar manner to the management of a network thermal constraint). The project achieved its objective of reducing station peak demand to provide additional demand capacity, as shown in section 5.8 of the closedown report. The installation of the battery has facilitated capacity for additional renewable generation. **References:** ▪ 1MW Battery, Shetland closedown report; July 2014.
Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Some indication that the project is could deliver significant financial benefits in the long term (ED2 and beyond) to selected group of customers.* **Evidence:** Financial benefits for customers are not specifically mentioned in the closedown report. However, there were several renewable energy projects being developed in Shetland that will receive a managed connection under the follow on NINES project. This means that there could be a financial benefit for a limited number of customers involved in these projects. **References:** ▪ 1MW Battery, Shetland closedown report; July 2014.

Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or be used in follow on projects.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** Learning from the operation of this project will inform SHEPD on the use of batteries in terms of BAU. The outputs of the project are intended to feed into a future BAU solution. The closedown report states that commercial considerations will play a large part in determining the optimum mix of varying technologies within a future BAU solution. The project is a precursor to the 'Northern Isles New Energy Solutions' NINES project. Without the NINES project, no new renewable generation would have been connected to the Shetland network and the island renewables would continue to be constrained by the technical limitations of an ageing oil fired power station. 8MW of renewables has displaced up to 15GWhrs of oil fired generation each year. **References:** ▪ 1MW Battery, Shetland closedown report; July 2014.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist or is covered in a good level of detail in the closedown report.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** A project closedown report exists, which provides technical specification for the battery. The project feeds into the Northern Isles New Energy Solutions (NINES2) project. In early 2012, SHEPD and EATL jointly instigated the Energy Storage Operators Forum (ESOF). This forum is now well established - the group was responsible for presenting a breakout session on energy storage dissemination at the 2013 LCNF conference. **References:** ▪ 1MW Battery, Shetland closedown report; July 2014.
Focuses on network methods that are at the trialling stage	**4**	**Assessment:** *Solution moved to TRL8 (complete and qualified by end of trial), or commercial solution developed suitable for roll out.* **Evidence:** The project closedown report states that: "Assessment against the TRL levels would indicate the TRL of the lead-acid BESS to be between 8 and 9." The TRL in the project application was stated as 7. Project considered to have been move to TRL8. **References:** ▪ 1MW Battery, Shetland closedown report; July 2014

Orkney Energy Storage Park

Project Title	Orkney Energy Storage Park
Tier	**1**
DNO	**SSE**
Status	**Complete**
LCNF project funding	**£175k**
Project objectives	The scope of this project is the creation of commercial incentives to encourage an Energy Storage Provider (ESP) to locate an Energy Storage System (ESS) where it would provide real benefits to a DNO. Objectives: 1 - Create commercial contracts that will incentivise 3rd Party ESPs to locate on a constrained distribution network. 2 - Prepare a tender process that will ensure that the ESPs selected will fulfil the success criteria. 3 - Design up to 2 connection points for ESSs outside KPS. 4 - Award up to 2 ESPs.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** The project looked at commercial incentives for the connection of Energy Storage Systems. An additional benefit was to provide an appraisal of the suitability of the connection process for storage devices. The project highlighted there are potential benefits to be realised, in terms of network operation, by devising a new connection process which incentivises connection by specific customer types in specific locations. The project looks at methods to facilitate the connection of new generation or demand. Carbon benefits are not specifically quantified. **References:** ▪ Orkney Energy Storage Park; Tier 1 Close-Down Report; November 2012.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Evidence that the project is likely to deliver significant financial benefits in the long term (ED2 and beyond) to selected group of customers.* **Evidence:** The closedown report states that DNOs will potentially be able to have lower project costs for safety appraisal of Lithium Ion technologies, which in turn will mean lower costs to DNO customers. The report notes that this project, and follow on projects, will help clarify a number of unknowns and lead to improved maturity in the storage market, which will give benefits to other DNOs and their customers. The project is considered to have potential to bring financial benefits to customers looking at connecting storage. These benefits could be comparatively long-term. **References:** ▪ Orkney Energy Storage Park; Tier 1 Close-Down Report; November 2012.
Has a Direct Impact on the operation of a DNO's Distribution System	4	**Assessment:** *The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The project successfully integrated Active Network Management and Energy Storage. The project has potential to improve network operation. However, there are still many unknowns. For this reason there are a number of follow on SSE projects to help clarify the unknowns and move the solution towards BAU. The first of these is a second tier 1 project – Trial of Orkney Energy Storage Park (Phase 2). The output of both these projects feeds into the Tier 2 Northern Isles New Energy Solutions project. **References:** ▪ Orkney Energy Storage Park; Tier 1 Close-Down Report; November 2012. ▪ Questionnaire response
Generates knowledge that can be shared amongst all DNOs	4	**Assessment:** *Specific replication report(s) exist / are available on request.* *There is no evidence of a learning dissemination event or webinar.* **Evidence:** The tables in section 11 of the closedown report list all physical components and knowledge required to replicate the outcomes of this project. In addition to this, further detail on any aspects are available from SSEPD via and email provided in the closedown report. There is no evidence of a learning dissemination event or webinar. **References:** ▪ Orkney Energy Storage Park; Tier 1 Close-Down Report; November 2012.

Focuses on network methods that are at the trialling stage	**1**	**Assessment:** *Solution has not progressed - technology level, has not progressed or commercial arrangements* **Evidence:** The TRL was noted as 6 in first tier pro-forma. There is no mention of TRL in the closedown report. The project achieved a number of key processes which would also the trial of the energy storage park to be tested in the Phase 2 project. However, the system prototype was not demonstrated in operational environment by the end of the project so it is not considered to have moved to TRL7. **References:** ▪ Orkney Energy Storage Park; Tier 1 Close-Down Report; November 2012. ▪ First tier pro-forma

Trial of Orkney Energy Storage Park (Phase 2)

Project Title	Trial of Orkney Energy Storage Park (Phase 2)
Tier	1
DNO	SSE
Status	Complete
LCNF project funding	£1.51m
Project objectives	The scope of this project is to better understand what commercial markets can be entered into by ESPs operating their systems whilst connected to a distribution network. Objectives: 1 - Enter into a commercial contract with an ESP to provide constraint management services. 2 - Modify existing generator and energy storage ANM interface to allow import requests to be sent to the ESS. 3 - Facilitate the connection of an ESS to the distribution network in Kirkwall. 4 - Service the contract over a 3-year period. 5 - Summarise the different markets the ESP has managed to access during the project.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** The project facilitated the connection of an ESS to the distribution network in Kirkwall. The project successfully deployed and managed a constraint management contract. The learning of the project should help to facilitate connection of new low carbon generation and demand. **References:** ▪ Trial of Orkney Energy Storage Park; Close down report; June 2015.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is likely to deliver significant financial benefits in the long term (ED2 and beyond) to selected group of customers* **Evidence:** The primary purpose of the ESS asset is to reduce the curtailment of distributed generation assets on Orkney. The closedown report states that curtailment avoidance is of benefit to the customers who operate the wind generation projects. **References:** ▪ Trial of Orkney Energy Storage Park; Close down report; June 2015.
Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects. The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The project has been a success as the business case behind the deployment of ESSs has been understood with the key sensitivities identified. The main conclusion from the project was that the business case for the battery would be positive, provided that a number of conditions were met. SSE has taken the sensitivities forward for further investigation, using Business as Usual (BaU) funding, to tender for constraint management services from third parties in their Southern Energy Power Distribution license area in order to keep the network within tolerance, whilst deferring larger scale network reinforcement. Without this, and the previous project the Constraint Managed Zone (CMZ) would have taken longer to start as the commercial learning would not have been developed and there would have been reduced knowledge to feed into the Energy Storage Operators Forum (ESOF) and subsequently the Good Practice Guide that ESOF produced The outputs of the project are also being used in the Northern Isles New Energy Solutions project. **References:** ▪ Trial of Orkney Energy Storage Park; Close down report; June 2015. ▪ Questionnaire response

Generates knowledge that can be shared amongst all DNOs	**4**	**Assessment:** *Specific replication report(s) exist / are available on request.* *There is no evidence of a learning dissemination event or webinar.* **Evidence:** The tables in section 12 of the closedown report list all physical components and knowledge required to replicate the outcomes of this project. In addition to this, further detail on any aspects are available from SSEPD via and email provided in the closedown report. There is no evidence of a learning dissemination event or webinar. **References:** ▪ Trial of Orkney Energy Storage Park; Close down report; June 2015.
Focuses on network methods that are at the trialling stage	**4**	**Assessment:** *Solution moved to TRL8 (complete and qualified by end of trial), or commercial solution developed suitable for roll out.* **Evidence:** First tier pro-forma states starting TRL as 6. Following the project, it is judged that the TRL has risen to 8 because of the ability to deploy and manage a constraint management contract has been learned through the project. **References:** ▪ Trial of Orkney Energy Storage Park; Close down report; June 2015. ▪ Trial of Orkney Energy Storage Park; First tier pro-forma

E.5 Fault Level Management

33kV Superconducting Fault Current Limiter (SFCL)

Project Title	**33kV Superconducting Fault Current Limiter (SFCL)**
Tier	1
DNO	NPG
Status	Closed
LCNF project funding	£2,880,000, (total project value £3,200,000) Final LCNF £2,738,724
Project objectives	This project was designed to trial a specific piece of new equipment that has a direct impact on the operation and management of the distribution system. The first phase of the project was to identify suitable locations for the installation and undertake a feasibility and systems readiness study to analyse the network, outlining the optimum application and specification, and confirm the business and carbon cases. The second phase was to design, build, install and commission a three-phase 33kV superconducting fault current limiter on the Northern Powergrid distribution network. It was proposed, and following site surveys, agreed with National Grid, that the unit was installed at a 275/33kV substation in South Yorkshire to facilitate future connection of DG and additional load by limiting the likely increase in fault current to within the rating of the 33kV switchgear. Increase in fault level is typically managed through an operational management switching procedure which, in limited circumstances, may increase the risk of loss of supplies to customers.

Assessment Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	1	*Overtaken by another initiative* If successful would allow connection of DG without increasing rating of switchgear. There were difficulties in creating a standard approach to the carbon case and this project requirement was subsequently overtaken by discussions at Ofgem's Innovation Working Group where a standard approach to carbon benefits was identified and captured as best practice.
Has the potential to deliver net financial benefits to future and/or existing customers	-	*Whilst the project produced learning it did not achieve its objectives* The project has been brought to a conclusion without achieving the stated objectives. The SFCL device failed high voltage testing twice, insertion losses were higher than expected – though deemed acceptable. The specification provides a description of the electrical network configuration and the works necessary to facilitate the connection of the SFCL, which includes the installation of a new 33kV circuit breaker, isolators and earth switches and associated protection Phase 1 completion report, Appendix 2
Has a Direct Impact on the operation of a DNO's Distribution System	1	*At present there is no potential for future replication* Whilst NPG state they have sufficient confidence to recommend 11kV fault current limiters in general for use as a business as usual option this project was looking at superconducting FCL at higher voltages. The learning gained was being used to create the appropriate standards and design policies.
Generates knowledge that can be shared amongst all DNOs	3	*A learning dissemination event or webinar was held but there are no specific replication reports* Any intellectual property rights generated were retained by ASL and would not put into the public domain. A dissemination event, to review the key learning, from this and the previous 11kV project was held during October 2014. A field visit to see the fully working 11kV SFCL unit was also undertaken. Those attending included all of the other GB DNOs, several manufacturers of fault current limiters and several other interested parties such as Tata Steel and ETI.
Focuses on network methods that are at the trialling stage	1	*Solution has not progressed with respect to technology level, or commercial arrangement* No discussion on TRL levels in close-out report. Searches for the technology provider have not found recent evidence that the new owner offers this solution Closedown report January 2015

Implementation of an Active Fault Level Management Scheme

Project Title	**Implementation of an Active Fault Level Management Scheme**
Tier	**1**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£646k**
Project objectives	The primary objective of the project was to expedite the connection of a new combined heat and power (CHP) plant. The project will encompass an 11kV substation area and associated distribution network so as to monitor, actively, the fault level. This will facilitate the management of the new CHP plant connection. The active management solution is required as an interim measure whilst the two low impedance 132 / 11 kV transformers at the substation are replaced with higher impedance transformers, removing any potential fault level issues.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** The accommodation of distributed generation within 11kV networks may be limited at present due to fault level issues. The implementation of an active fault level management scheme has the potential to defer and/or avoid costly network reinforcement, whilst increasing network security. This facilitates the installation of distributed generation close to large demand centres, which has the potential to reduce electrical distribution losses and increase the efficiency of the Distribution System. **References:** ▪ Implementation of an active fault level management scheme; Closedown report; March 2015.
Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is likely to deliver financial benefits in the long term (ED2 and beyond) to selected group of customers.* **Evidence:** Financial benefits for the customer are not discussed in the closedown report. However, the project is about facilitating the connection of low carbon generation, which is likely to have benefits to those customers wishing to make such connections. **References:** ▪ Implementation of an active fault level management scheme; Closedown report; March 2015.

Has a Direct Impact on the operation of a DNO's Distribution System	**3**	**Assessment:** *The project is ready to roll out when the energy landscape requires the solution* *The project has a reasonable likelihood of being replicated by other DNOs.* **Evidence:** The work carried out in this LCNF Tier-1 project has significantly de-risked the implementation of the AFLM device for FlexDGrid (Tier 2 project which utilises the outputs of this project). The solution is not yet a BAU activity. However, two policies relating to the project are now in place within WPD. The AFLM device to be documented in WPD's standard asset register system CROWN, which enables a standard maintenance regime to developed and carried out. **References:** ▪ Implementation of an active fault level management scheme; Closedown report; March 2015.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist / are available on request.* *A learning dissemination event or webinar was held.* **Evidence:** The policies developed as part of the project have been made available to all DNOs. A paper on Implementation of an active fault level monitoring system for distributed generation integration (22nd International Conference on Electricity Distribution) is available on WPDs website, which provides technical detail on the project. Other technical details can be found in the Appendices of the closedown report. The project was presented at the 2012 LCNF conference. **References:** ▪ Implementation of an active fault level management scheme; Closedown report; March 2015. ▪ Implementation of an active fault level monitoring system for distributed generation integration; 22nd International Conference on Electricity Distribution; Stockholm, 10-13 June 2013. ▪ Active Fault Level Management (presentation); Jonathan Berry; LCNF Conference; 25th October 2012.

Focuses on network methods that are at the trialling stage	**3**	**Assessment:** *Solution moved to TRL7 (system prototype demonstrated in operational environment), or commercial solution demonstrated in operational environment.* **Evidence:** TRL in the first tier project registration pro-forma was noted as 6-8. The closedown report states that the initial TRL was 6 and that, following successfully integration of the device, the TRL has to 7. Further developments are required to improve the TRL to 8. **References:** ▪ Tier 1 project registration pro-forma. ▪ Implementation of an active fault level management scheme; Closedown report; March 2015.

E.6 Flexible Demand

Demonstrating the Functionality of Automated Demand Response (ADR)

Project Title	**Demonstrating the Functionality of Automated Demand Response (ADR)**
Tier	1
DNO	SSEPD
Status	Closed
LCNF project funding	£260,000
Project objectives	▪ Furnish all data required for a DNO to quantify the benefits of the Automatic Demand Response (ADR) system; ▪ Drive rapid enrolment by providing required hardware, software, consulting and training to the participating building owners enrolled on the programme; ▪ Demonstrate interoperability of systems and by adhering to the standards and open protocols, ensuring long term lifecycle of assets; ▪ Demonstrate compliance to various elements pertaining to cyber security;

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits not specifically quantified* **Evidence:** No carbon savings quantified from the project, some discussion of CO2 impact for the ADR sites. Carbon savings might come from two routes: ▪ Reduction of electricity demand at the ADR sites, assuming that demand shifted is not replaced by higher demand at a different time of day ▪ That peak demand will probably coincide with the operation of higher carbon generation (e.g. open cycle GT). So less carbon by virtue of a changed generation mix Neither of the above are discussed or quantified in the close-out report **References:** ▪ Close down report

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Compelling evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to the majority of customers* **Evidence:** No additional financial incentive for customers in the trial, other than reduction in consumption and possibly max demand or TUoS charges. The direct benefit to the ADR customer does not seem to have been calculated. Cost benefit varies widely between winter and summer demand reduction, summer offers bigger demand reduction (probably due to chiller loads). “It is estimated that the net present value of ADR is between £56,700 and £97,000 per building over 30 years.” Benefit is peak network demand reduction – it is clear that ADR is cheaper than reinforcement. Fixed costs mean that larger buildings need to be targeted. So potential for net financial benefits is shown – based on a small sample – but if sufficient sites were done to avoid a system upgrade then all that DNO’s consumers would benefit. **References:** ▪ Close down report, October 2012
Has a Direct Impact on the operation of a DNO’s Distribution System	4	**Assessment:** *The project has been /is ready to roll out into BAU. The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The ADR system is a commercial product from Honeywell. The Tier 1 project has provided some practical insight into how to engage customers, the type of customer needed, the cost and time to recruit customers etc. It also established aspects of technical functionality (performance of Honeywell's equipment in dropping the customer's demand), overcoming IT issues (firewall management) and the legal process (use of relevant standard clauses and recognition of risk allocation) which enabled the NTVV project to progress with the roll out of 30 demand response installations. This is not a complex solution – so roll-out has few barriers. **References:** ▪ Close down report ▪ SSE Questionnaire response

Generates knowledge that can be shared amongst all DNOs	**2**	**Assessment:** *No dissemination other than close-out report* **Evidence:** Learnt that it takes time and some budget to recruit clients for ADR - £8k now estimated. No dissemination activities mentioned in the close-out report. No dissemination activities found on SSE website. **References:** Close down report
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment* **Evidence:** The Honeywell ADR system did not need development – so this was demonstration of an existing technology.

Trial Evaluation of Domestic Demand Side Management (DDSM)

Project Title	**Trial Evaluation of Domestic Demand Side Management (DDSM)**
Tier	**1**
DNO	**SSE**
Status	**Complete**
LCNF project funding	**£280,000**
Project objectives	This project sought to install DDMS in 6 houses with suitable control and signalling back to a central control hub. The aim being to control domestic electrical heat demand during times of network strain such as exceptionally low or high demand periods. Heat storage devices (immersion water heaters & space storage heaters) was installed with control systems enabling them to become inertial energy storage devices on the electrical network, thus allowing the local DNO to have a degree of control over local demand response and frequency response.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits not specifically quantified* *The carbon benefits are not specifically quantified.* **Evidence:** The project achieved its aim of allowing the local DNO to have a degree of control over local demand response and frequency response. Managing peak demand will enable to connection of LCTs. The carbon benefits are not specifically quantified. **References:** ▪ SSEPD Low Carbon Networks Fund Tier 1 Project Close-Down Report; Oct-12.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Indication that the project is likely to deliver financial benefits to the majority of customers, but that these benefits may be comparatively short term.* **Evidence:** In addition to the network benefits, the design of the project was projected to benefit customers by providing a more efficient and controllable heating system. An outcome of the project was that some tenants began to see the benefits in terms of savings on energy use and cost. There are therefore financial benefits for customers associated with the project, although these are not specifically quantified or determined as short or long-term. **References:** ▪ SSEPD Low Carbon Networks Fund Tier 1 Project Close-Down Report; Oct-12.
Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or be used in follow on projects.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** This trial has demonstrated the functionality of a DDSM system and provided an initial indication of the network and customer benefits. The introduction of the controllable demand along with battery and ANM has allowed further renewables to be connected on the islands. This has directly reduced the reliance on the existing oil fired power station. In addition the new heating systems provide the home owners with a far greater degree of comfort and flexibility. There is also evidence to suggest that this has resulted in an energy saving for the majority of customers. The next step required for progression towards Business as Usual (BAU) deployment is to trial dynamic scheduling and control. This is being carried out through a large-scale roll out to 750 homes in Shetland through SHEPD's Northern Isles New Energy Solutions (NINES2) project. **References:** ▪ SSEPD Low Carbon Networks Fund Tier 1 Project Close-Down Report; Oct-12. ▪ Questionnaire response

Generates knowledge that can be shared amongst all DNOs	**4**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *There is no evidence of a learning dissemination event or webinar.* **Evidence:** A project closedown report exists, which provides technical specification for various elements of the project solution. The project feeds into the Northern Isles New Energy Solutions (NINES2) project. There is no evidence of a specific learning event. However, a website exists for the NINES project, which contains a learning section with details of the projects that have fed into it. **References:** ▪ SSEPD Low Carbon Networks Fund Tier 1 Project Close-Down Report; Oct-12. ▪ http://www.ninessmartgrid.co.uk/learningandpublications/
Focuses on network methods that are at the trialling stage	**3**	**Assessment:** *Solution moved to TRL7 (system prototype demonstrated in operational environment), or commercial solution demonstrated in operational environment* **Evidence:** The project advanced the Technology Readiness Level (TRL) level from 6 to 7, as an actual system prototype has been demonstrated in a working environment. The NINES project will allow the technology to be tested, both at scale and by integrating it into an existing system –advancing the TRL to 8 – and enabling SHEPD to determine the value of DDSM to DNOs. **References:** ▪ SSEPD Low Carbon Networks Fund Tier 1 Project Close-Down Report; Oct-12.

Community Energy Action

Project Title	**Community Energy Action**
Tier	**1**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£434,565**
Project objectives	The scope of this project was to work with 10 communities to gather demand data while implementing incentive tariffs. This would be aided by community demand data being made available. In addition to this a community energy monitor would be developed to allow customers to see at a glance what their demand and the entire community demand is. Community monitor solution would be generic and available for use in future.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project learning facilitates understanding of demand response which could facilitate connection of LCTs by deferring asset reinforcement.* **Evidence:** WPD wanted to investigate whether engagement on a community level would be an alternative to conventional reinforcement and what was the most appropriate way to do this. The benefit of this project was to see if using demand side response can reduce the peak demand thus allowing deferral or removal of conventional reinforcement which could reduce demand driven reinforcement significantly. Additionally, due to communities being selected with preference of low carbon technologies indicative demand data for communities of the future was obtained. While the project determined that the cost of incentives and customer engagement significantly outweigh conventional reinforcement, there have been other learning benefits. **References:** ▪ Community Energy Action; Closedown report; June 2015.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project methods can deliver financial benefits to the majority of customers.* **Evidence:** Although the project determined the solution was not cost effective, there were financial benefits to customers in terms of energy saved and reduced bills. **References:** ▪ Community Energy Action; Closedown report; June 2015.
Has a Direct Impact on the operation of a DNO's Distribution System	**2**	**Assessment:** *The project has learning and outputs are utilised in later LNCF projects.* **Evidence:** As the project set out to explore if community engagement lead demand side response was a valid option for network constraint management and there was not a statistical significant impact and was significantly more expensive than conventional reinforcement, this sort of intervention will not be taken forward to business as usual. However, the project does hold useful learning for future demand side response services purchased from community groups or ESCOs. The project learning is being used in Flexible Plug and Play (Tier 2 project), but the solution is unlikely to be used by other DNOs at present. Project does provide learning for other situations, such as for future demand side response services purchased from community groups or ESCOs. **References:** ▪ Community Energy Action; Closedown report; June 2015.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist / are available on request. A learning dissemination event or webinar was held.* **Evidence:** As well as the closedown report, a CSE report and appendices provide detail on the project. Findings were disseminated at the 2014 and 2015 LCNI conference. **References:** ▪ Community Energy Action; Closedown report; June 2015. ▪ Community Energy Action (Less Is More) ; Final report of the LCNF Community Energy Action project; Centre for Sustainability; 2014 (and Appendices document).

Focuses on network methods that are at the trialling stage	**3**	**Assessment:** *Whilst the solution has not progressed with respect to technology level, or a commercial arrangement the findings in respect of residential consumer response are significant for industry learning.* **Evidence:** TRL 7 in Tier 1 project registration pro-forma. TRL is not discussed in the closedown report. The solution was trialled, although it was determined not to be cost effective compared with conventional reinforcement. **References:** ▪ Tier 1 project registration pro-forma. ▪ Community Energy Action; Closedown report; June 2015.

E.7 Asset Rating

Implementation of Real-Time Thermal Ratings

Project Title	Implementation of Real-Time Thermal Ratings
Tier	1
DNO	Scottish Power
Status	Complete
LCNF project funding	The original project cost was £450,000, whereas, the actual project cost £620,000 (+37%).
Project objectives	The key objectives of this project were to: ▪ Release network capacity for 132kV wind generation; ▪ Provide SP Energy Network's control room with complete thermal visibility of the North Wales 132kV overhead line network from Connah's Quay to Pentir; ▪ Gain business confidence to move forwards to offering active network management (ANM) solutions for prospective generation customers.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	*The project clearly facilitates the connection of low carbon generation or demand, the carbon benefits not specifically quantified* **Evidence:** The project proves that RTTR can be used to support ANM – which in turn would allow greater renewable energy capacity to be connected, and/or to increase the generation output from capacity already connected. The evidence for this potential is strong within the close out report. However the scope of the project does not take the additional step of using RTTR with ANM and hence increasing low carbon generation connection. The amount of additional wind generation is quantified, but the amount of carbon saved is not calculated. **References:** ▪ Close down report, October 2013

Has the potential to deliver net financial benefits to future and/or existing customers	-	*Evidence that the project may deliver short-term financial benefits to a limited group of customers (e.g. associated with asset replacement deferment).* **Evidence:** The use of RTTR would potentially reduce connection cost for generators in areas with network constraints. The NPV of RTTR vs. network reinforcement is clearly shown in the close out report. However this is not translated into the financial benefits for customers. The beneficiaries if RTTR and ANM if rolled out would be generation connectees. There are no obvious benefits for demand customers. The benefits for generation connectees would be short to medium term (if this allows more connections, the uplift per connectee would gradually reduce). **References:** ▪ Close down report, October 2013
Has a Direct Impact on the operation of a DNO's Distribution System	3	*The project is ready to roll out when the energy landscape requires the solution. The project has a reasonable likelihood of being replicated by other DNOs* **Evidence:** The RTTR system will be relevant to DNOs with high levels of renewable energy generation connected at EHV level. This will be most, but not all of DNOs. A pre-condition for use of RTTR is the wider use of ANM. SPEN plan to roll this out to cover ▪ 33kV networks ▪ The ARC Tier 2 project ▪ Transmission networks SPEN are considering the use of DLR technology for a 132kV interconnection between Barlaston and Crewe. However, there has not yet been a BAU deployment of the technology as its primary application is to alleviate capacity issues on OHL connecting on shore wind farms. Since the conclusion of the project the volume of on shore windfarm connection applications has drastically dropped off due to policy changes and no projects have been identified for which real-time rating would be a viable solution. **References:** ▪ Close down report, October 2013 & Questionnaire response

Generates knowledge that can be shared amongst all DNOs	**3**	*A learning dissemination event or webinar was held but there are no specific replication reports* **Evidence:** Activities ▪ Four academic papers published –some may be a result of the previous R&D project as they predate this Tier 1 project. ▪ Event organised in 2013 ▪ The close out report lists the information and insight that would be needed for replication however links in the close out report do not lead to the documents associated with this project. **References:** ▪ Close down report, October 2013
Focuses on network methods that are at the trialling stage	**3**	*Status at the end of the project aligns with TRL7* **Evidence:** The preceding R&D phase was the recipient of the Institution of Engineering and Technology (IET) Innovation Award in the Power / Energy Category in 2010 Section 5.5 of the close out report states that the project: "…has increased from TRL 5 (Technology component and/or basic technology subsystem validation in a relevant environment) to TRL 7 (Technology system prototype demonstration in an operational environment)." **References:** ▪ Close down report, October 2013

Temperature Monitoring Windfarm Cable Circuits

Project Title	**Temperature Monitoring Windfarm Cable Circuits**
Tier	**1**
DNO	**SPEN**
Status	**Complete**
LCNF project funding	**£710,504**
Project objectives	The scope of the project was to determine dynamic cable ratings for three cable circuits (3 - 33kV) and assess the impact the renewable generation from the three windfarms will have on these circuits. From this analysis the prospect of further network capacity being available would be determined.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project facilitates the connection of low carbon generation or demand.* **Evidence:** Initial outputs suggested that there may be additional network capacity available, which could be utilised if the windfarm developers decide to increase their outputs and potentially network reinforcement could be deferred or cancelled. The outputs of the project can be further explored by estimating the firm and non-firm connection capacity for future generation connection applications The work is continuing under a new NIA registered project. **References:** ▪ Temperature Monitoring Windfarm Cable Circuits; Close down report; July 2015.
Has the potential to deliver net financial benefits to future and/or existing customers		**Assessment:** *Indication that the project is likely to deliver financial benefits to customers. However, the financial benefits and the scale/term of these are not set out.* **Evidence:** The project closedown report states that the results and learning from this project demonstrated that both the SPEN and windfarm connection customers could benefit from deploying a real-time cable temperature monitoring system. However, financial benefits to customers are not explicitly set out. **References:** ▪ Temperature Monitoring Windfarm Cable Circuits; Close down report; July 2015.

Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** One of the outcomes of this project is that it was recommended that micro-ducting is considered as a business as usual practice as part of future cable installations. The key learning and experiences gained on this project is being used to inform the adoption of similar cable temperature monitoring solutions on three BAU cable installation projects which have been specified with Distributed Temperature Sensing (DTS) technology: **(i)** Western HVDC link where cable temperature will be monitored at both ends of circuit **(ii)** 400kV Torness cable circuit **(iii)** Hunterston - Kintyre subsea cable circuit The follow on NIA project is looking at developing policy documents and technical specifications for future dynamic temperature sensing and dynamic cable rating systems for Business as Usual application. **References:** ▪ Temperature Monitoring Windfarm Cable Circuits; ▪ Close down report; July 2015; ▪ Questionnaire response.
Generates knowledge that can be shared amongst all DNOs	**3**	**Assessment:** *The only replication information available is in the closedown report.* **Evidence:** Section 11 of the closedown report shows knowledge, IPR, data, products and services required to replicate the real-time cable temperature monitoring system. Points of contact are provided for further information, although no specific replication reports are mentioned. There is no evidence of a dissemination event. **References:** ▪ Temperature Monitoring Windfarm Cable Circuits; Close down report; July 2015.

Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment.* **Evidence:** TRL 8 in project pro-forma. TRL is not specifically discussed in the closedown report. The dynamic temperature sensing and dynamic cable rating solution was implemented as part of the project and Scottish Power Energy Networks plan to conduct a new project under the NIA funding mechanism to prepare DTS and DCR systems for full business adoption. The solution is therefore considered to be proven in an operational environment. **References:** ▪ First Tier Pro-forma ▪ Temperature Monitoring Windfarm Cable Circuits; Close down report; July 2015.

E.8 Storage

Demonstrating the Benefits of Short-Term Discharge Energy Storage on an 11kV Distribution Network

Project Title	**Demonstrating the Benefits of Short-Term Discharge Energy Storage on an 11kV Distribution Network**
Tier	**1**
DNO	**UKPN**
Status	**Complete**
LCNF project funding	**£225,000**
Project objectives	The objectives of this project are to: ▪ perform validation of a storage device’s capabilities with respect to data sheet performance, when installed on a real network. Specifically, the efficiency of the device will be measured; ▪ demonstrate load-shifting within the limits of the device capability (200kWh, 1-hour discharge duration); ▪ understand the extent to which these interventions could be scaled up to manage larger quantities of demand or generation; ▪ validate a number of use-cases and understand their relative value to the DNO and to an intermittent generator; ▪ understand the potential lifetime of the device; ▪ embed the learning into a design tool for network planners, and into dissemination material for the UK DNO community; and ▪ propose next steps.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** The aim of the trial was to explore how electricity could be stored to overcome the challenge of intermittent power production from renewable sources. The battery technology was tested to see how much electricity could be stored from local wind turbines when power generation exceeds demand. In particular, the trial explored the potential to reduce voltage fluctuations and manage demand on the distribution network. This enables the accommodation of additional demand or generation on the existing feeders, within the thermal limits of the plant and circuit, without breaching voltage limits or needing to curtail generation. One of the three main benefits for stakeholders was noted in the closedown report as, demonstrating that storage could enable more renewable generation or additional load to be connected to the network without the need for conventional reinforcement. **References:** ▪ Demonstrating the benefits of short-term discharge energy storage on an 11kV distribution network; Close down report; June 2014.
Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Indication that the project is likely to deliver some financial benefits to a selected group of customers.* **Evidence:** While direct financial benefits for customers are not really outlined, figure 18 in the closedown report shows an example of the financial impact of an example daily operation in terms of import charge to export revenue. This shows that there are likely to be some financial benefits for renewable energy generators, although these may be small scale. **References:** ▪ Demonstrating the benefits of short-term discharge energy storage on an 11kV distribution network; Close down report; June 2014.

Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects. The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The closedown report notes that, for this technology to become part of business as usual operations and be a suitable smart alternative to traditional network interventions, the reliability of the full storage facility will have to improve significantly. Areas such as interoperability will have to be addressed. Section 8.4.6 outlines the steps necessary to ensure a successful transition into Business as Usual. UKPN have stated that although the battery is not being put into business as usual, the success of this project proved that it was technically feasible for energy storage to help DNOs create capacity and provide financial benefits to customers; and enabled UKPN and other DNOs to proceed with larger-scale storage projects, e.g. SNS (UKPN) and CLNR (NPG). It is planned to decommission the site, and transfer the energy storage modules to Newcastle University's Energy Storage Test Bed, where they will continue to generate further learning for the low-carbon energy sector. **References:** ▪ Demonstrating the benefits of short-term discharge energy storage on an 11kV distribution network; Close down report; June 2014 & UKPN Questionnaire response
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist / are available on request. A learning dissemination event or webinar was held.* **Evidence:** The operational experience required to replicate the project has been disseminated through the following initiatives: Early Learning Report: October 2012; LCNF Conference: October 2012, November 2013; ESOF meetings; the close down report. Additional details on knowledge dissemination (including specific events and papers), as well as contact details for further information are provided in Appendix B of the closedown report (although it was noted that many of the links are no longer working). A detailed system overview of provided in Appendix C, detailed results in Appendix D and the storage modelling tool in Appendix E. Outline details of the project are also available on UKPN's innovation webpage. **References:** ▪ Demonstrating the benefits of short-term discharge energy storage on an 11kV distribution network; Close down report; June 2014. ▪ http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-1-projects/demonstrating-the-benefits-of-short-term-discharge-energy-storage/

Focuses on network methods that are at the trialling stage	**3**	**Assessment:4** *Solution moved to TRL7 (system prototype demonstrated in operational environment), or commercial solution demonstrated in operational environment.* **Evidence:** TRL is not specifically mentioned in the closedown report. Considered that technology is at least at TRL 7 (technology validated in relevant environment). Commercial arrangements are being looked at as part of the Tier 2 Smarter Network Storage project. **References:** ▪ First tier project registration pro-forma ▪ Demonstrating the benefits of short-term discharge energy storage on an 11kV distribution network; Close down report; June 2014.

LV Network Connected Energy Storage

Project Title	**LV Network Connected Energy Storage**
Tier	**1**
DNO	**SSE**
Status	**Complete**
LCNF project funding	**£310,000**
Project objectives	▪ Prove the batteries and power conversion units can operate as intended on an LV network in the UK and have a tangible benefit electrically. ▪ Inform the establishment of the economic threshold for this technology. ▪ Validate the technical specification to inform and de-risk the tendering exercise for the Tier 2 project. ▪ Define, test and prove the communications and the associated data transfer requirements for this small trial and inform that required for a larger array. ▪ Inform the safety case and the operational procedures including installation, maintenance and operational work on a network with storage connected (faults, protection. live working, safety procedures etc.) ▪ Inform decisions regarding the physical location of storage devices given public perception and acceptance.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** The study was carried out to determine the potential benefits, practicalities and costs of installing electrical energy storage (ESS) connected via 4 quadrant power conversion systems (PCS) on the LV network. The ESS units with associated PCS have the potential to aid power quality, to manage reactive power flows and to reduce the peak demand / peak generation real power flows, through peak lopping. This has the potential to delay or reduce the need for traditional network reinforcement, thereby preventing the local DNO network from becoming a barrier to the deployment of low carbon technologies. **References:** ▪ Low Voltage Connected Energy Storage closedown report; 2014.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Little or no evidence that the project will deliver financial benefit to customers.* **Evidence:** (Financial) benefits to customers are not specifically outlined in the project closedown report. Learning from this project has fed into the Tier 2 New Thames Valley Vision project, which is expected to have customer benefits. **References:** ▪ Low Voltage Connected Energy Storage closedown report; 2014.
Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The learning fed into the NTVV project (tier 2 – New Thames Valley Vision) from this Tier 1 should result in a solution fit for business as usual rollout in 2016. The project was the first in the UK to prove the theoretical benefits of energy storage such as peak shaving, phase balancing and voltage manipulation. Learning from the project also directly supported the implementation of a number of Lithium Ion based energy storage projects within SSEPD and other DNOs such as UKPN and NPG. Learning was gained in terms of the safety case installation and operation of the lithium ion batteries, the cost of procuring installing and operation the batteries. This allowed for the development of codes of practice and the establishment of the Energy Storage Operators Forum (ESOF). **References:** ▪ Low Voltage Connected Energy Storage closedown report; 2014. ▪ Questionnaire response
Generates knowledge that can be shared amongst all DNOs	**3**	**Assessment:** *The only replication information available is in the closedown report.* **Evidence:** Section 11 of the closedown report lists all the physical components and required to replicate the outcomes of this project, showing how the required data can be accessed by other GB DNOs. Contact email is provided for further information, although no specific replication reports are mentioned. There is no evidence of a dissemination event. **References:** ▪ Low Voltage Connected Energy Storage closedown report; 2014.

Focuses on network methods that are at the trialling stage	**3**	**Assessment:** *Solution moved to TRL7 (system prototype demonstrated in operational environment), or commercial solution demonstrated in operational environment.* **Evidence:** TRL 5 in project pro-forma. The closedown report states the project work has successfully taken the system from TRL 5 up to TRL 7. In order to move the technology to further towards business as usual a GB compliant voltage PCS and a demonstration of the unit operating on a constrained network would be required. The validation of a real network problem would prove the technology is ready to be deployed on mass. **References:** ▪ First tier project pro-forma. ▪ Low Voltage Connected Energy Storage closedown report; 2014.

E.9 Network Configuration

The 'Bidoyng' Smart Fuse

Project Title	**The 'Bidoyng' Smart Fuse**
Tier	1
DNO	ENW
Status	Closed
LCNF project funding	The original forecast at the time of Project Registration was £442,666, the final cost was £409,571.
Project objectives	The four specific objectives of the project were to; 1 Install 200 Smart Fuses, 100 for Electricity North West's fault restoration teams to be used in response to faults and moved around the low voltage network as required and 100 to be installed in a fixed location to monitor loads. 2 To gather data regarding the performance of low voltage networks, particularly in light of the significant amount of distributed generation in the form of domestic solar photo voltaic (PV) panels that were installed in 2009 and 2010. 3 To improve customer service by reducing the time to restore supplies following a fault. 4 To provide data to develop policies and procedures regarding the use of the Smart Fuse on low voltage networks.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** The monitoring of the LV system has the potential to support the growth of microgeneration, by providing real data on the pattern of generation, the net demand/export and key operating parameters (voltage, power factor, direction of power flow). If this insight is used to support further growth of microgeneration there could be carbon benefits – though this is not shown in the scope of this project. **References:** ▪ Close-down report, May 2014

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Compelling evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to the majority of customers* **Evidence:** National Fault and Interruption Reporting Scheme (NAFIRS) data for pre and post Bidoyng installation shows a fall on number of customers interrupted and a fall in customer minutes lost. The details are high level and for 1 year only. Close out report states that "it is estimated that an average penalty of £500 is avoided with every Smart Fuse low voltage feeder supply restoration." The project did not set out to calculate total financial benefit and did not undertake this task. It is clear that the reductions in CI and CML are significant and would be sustained for a wide number of customers – if Bidoyng fuses are adopted at scale. **References:** ▪ Close-down report, May 2014
Has a Direct Impact on the operation of a DNO's Distribution System	**5**	**Assessment:** *The project has been / is ready to roll out into BAU. Other DNOs have included the project in their business plans.* **Evidence:** The use of the Smart Fuse in Electricity North West is now written into Code of Practice 617 - Fault Location Techniques for the LV Underground Network. The fuse is marketed on the Kelvatek web site with a video showing the interest and use of the fuse by several DNOs. **References:** ▪ Close-down report

Generates knowledge that can be shared amongst all DNOs	**4**	**Assessment:** *ENWL can advise on the adoption of the smart fuse* **Evidence:** What began as a simple concept for a low voltage auto-reclosing device to meet a perceived has now grown into a significant business activity across a number of DNOs. The Smart Fuse is generating measurable financial benefits to DNOs and improved service to our customers and not least has created long term employment opportunities within Kelvatek. The Smart Fuse is a fully developed device and has the full technical and commercial support structure in place that would be expected of any commercially available technology. Electricity North West can advise any DNO on adoption of the Smart Fuse and discussions have already taken place at the time of writing with a number of DNOs who are assessing the potential costs and benefits of the Smart Fuse. **References:** ▪ Close-down report, May 2014
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment* **Evidence:** No discussion of TRL in the close-out report. The Bidoyng fuse was made in volume (200 off) for this project and no reports of design changes were seen. The fuse is marketed on the Kelvatek web site with a video showing the interest and use of the fuse by several DNOs. So TRL probably was TRL9 before and after the project. **References:** ▪ Close-down report, May 2014

Clyde Gateway

Project Title	Clyde Gateway
Tier	**1**
DNO	**SPEN**
Status	**Complete**
LCNF project funding	**£300,000**
Project objectives	The project objective was to demonstrate the integration of a number of smart grid components within an established infrastructure and facilitate the development of solutions in a number of areas including power quality, HV/LV automation, auto-sectionalising / load-transfer etc. The application of the latest technologies on various smart grid components on a relatively small network aimed to: ▪ Assist with the development of efficient and effective solutions. ▪ Provide learning outcomes not only on the smart aspects of the grid infrastructure but on design standards, network voltages and utilisation of assets. ▪ Inform industry and the supply chain on smart grid challenges and solutions.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** Part of the project was about trialling simultaneous measurement of voltage at various points on the network in order to inform design and operational practice with respect to impact of generation. The aim would be to allow more generation to be accommodated. The other methods trialled bring additional carbon benefits. **References:** ▪ Clyde Gateway LR1 (London Road 1); Close down report; April 2014.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *The project is highly likely to deliver financial benefits in the long term (ED2 and beyond) to the majority of customers.* **Evidence:** The application of the automation technology will significantly improve the reliability of HV and LV networks, delivering better performance to customers in terms of a reduction in regulatory customer minutes lost (CMLs). The financial benefits to customers are not specified in the closedown report. **References:** ▪ Clyde Gateway LR1 (London Road 1); Close down report; April 2014.
Has a Direct Impact on the operation of a DNO's Distribution System	**3**	**Assessment:** *The project is ready to roll out when the energy landscape requires the solution* *The project has a reasonable likelihood of being replicated by other DNOs.* **Evidence:** Since the trials did not progress as far as intended, SP Energy Networks does not have immediate plans to adopt the LV automation system into its Business as Usual operations. However, the outcomes of this project may be used in an NIA project. SP Energy Networks also has aspirations to utilise these technologies, and build on the learning from other DNOs, to demonstrate and implement HV/LV automation solutions in the future. **References:** ▪ Clyde Gateway LR1 (London Road 1); Close down report; April 2014.
Generates knowledge that can be shared amongst all DNOs	**4**	**Assessment:** *Specific replication report(s) exist / are available on request.* *There is no evidence of a learning dissemination event or webinar.* **Evidence:** The knowledge required to replicate this project is contained within the closedown report and the information provided in the Appendix. In addition, contacts have been provided where further detail can be requested for project replication. There is no evidence in the closedown report of a project dissemination event. **References:** ▪ Clyde Gateway LR1 (London Road 1); Close down report; April 2014.

Focuses on network methods that are at the trialling stage	**3**	**Assessment:** *Parts of the solution moved to TRL8 (complete and qualified by end of trial), or commercial solution developed suitable for roll out. Parts of solution remain at TRL 5.* **Evidence:** The tier 1 pro-forma indicated that, at the start of the project, the project elements ranged from TRL 5 to TRL 8. However, the project closedown report shows all elements of the project at TRL5 at the start of the project. At the end of the project two elements had been moved to TRL 8, while four others remained at TRL 5. **References:** ▪ Clyde Gateway LR1 (London Road 1); Close down report; April 2014. ▪ Tier 1 pro-forma.

E.10 Visibility

LV Current Sensor Technology Evaluation

Project Title	**LV Current Sensor Technology Evaluation**
Tier	**1**
DNO	**WPD (collaboration with UKPN)**
Status	**Complete**
LCNF project funding	**£250,000 per DNO**
Project objectives	1. The project aimed to evaluate innovative current sensor technologies in a controlled laboratory environment and field situations. 2. The project evaluated sensors from 7 manufacturers and the field trials lasted for 12 months. 3. The objective was to generate knowledge of LV monitoring techniques enabling wider roll-outs to facilitate a low carbon future and minimising disruption to customers.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** This project was developed to ensure that the DNO community would be better informed of the technical issues associated with the purchase of monitoring equipment. The financial benefits that could be realised would come from the wider roll out of monitoring equipment, and the use of the data to make smarter network reconfiguration or reinforcement decisions. There would also be financial benefits for customers as a better visibility of the LV network would allow the connection of additional Distributed Generation without the need for reinforcement. The project therefore has the potential to facilitate the connection of new low carbon generation. **References:** ▪ LV Current Sensor Technology Evaluation; LCN Fund Tier 1Close down Report; September 2013.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is likely to deliver financial benefits in the long term (ED2 and beyond) to selected group of customers.* **Evidence:** Stated in the closedown report that there would be financial benefits for customers as a better visibility of the LV network would allow the connection of additional Distributed Generation without the need for reinforcement. This would therefore benefit those wishing to connect low carbon generation. **References:** ▪ LV Current Sensor Technology Evaluation; LCN Fund Tier 1Close down Report; September 2013.
Has a Direct Impact on the operation of a DNO's Distribution System	**5**	**Assessment:** *The project has been / is ready to roll out into BAU or outputs are utilised in later LNCF projects. Other DNOs have included the project in their business plans or are utilising project outputs.* **Evidence:** The closedown report states that the manufacturer equipment, which has further developed over the course of the project, would now be available to DNOs for use in their business as usual processes and that any further innovation projects involving the installation of LV monitoring equipment or business as usual larger roll-out will be able to use the learning from this project. WPD have also developed a number of installation guides and draft policy which is was being developed for business as usual application. The learning from the project is being used in the LV Network Templates project. Since the LV Sensors project began, some changes have been made to the GridKey system. All these have been made based on direct feedback from this trial and working with other UK DNOs. UK Power Networks (UKPN) was separately investigating commercially available LV monitoring solutions that do not require customers to be interrupted during installation. WPD and UKPN decided to collaborate to evaluate a range of LV monitoring solutions and findings are detailed in the closedown report. **References:** ▪ LV Current Sensor Technology Evaluation; LCN Fund Tier 1Close down Report; September 2013.

Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist / are available on request.* *A learning dissemination event or webinar was held.* **Evidence:** The closedown report outlines the main learning from this project and is supported by detailed Appendices, which include NPL Laboratory Reporting, test descriptions and results, sample installation procedures and details and technical specifications of the individual sensors used in field tests. Manufacturer details are also provided. WPD hosted a substation monitoring knowledge sharing event on 11 July 2013 at the National Space Centre in Leicester. The day shared learning from six LCNF projects, but in particular the LV Sensor Evaluation trial. The day was attended by over 80 people, with representatives from universities, vendors, DNOs, government and blue chip organisations. Ten companies exhibited substation monitoring equipment, including the seven organisations taking part in this trial. **References:** ▪ LV Current Sensor Technology Evaluation; LCN Fund Tier 1Close down Report; September 2013.
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Moved from TPL 6 to TRL 9* actu*al system proven in operational environment* **Evidence:** TRL 6 in the tier 1 project registration pro-forma. TRL is not specifically discussed in the project closedown report. The closedown report states that, at this stage, retrofitting monitoring will be driven by trial projects rather than wide-scale rollout and that the outputs of this project will focus the choice and installation techniques where monitoring is required to support further trial projects. It is therefore considered that a system prototype has been proven in an operational environment as the equipment is available on the market. **References:** ▪ Tier 1 project registration pro-forma. ▪ LV Current Sensor Technology Evaluation; LCN Fund Tier 1Close down Report; September 2013.

Low Voltage Network Solutions

Project Title	**Low Voltage Network Solutions**
Tier	1
DNO	Electricity North West
Status	Closed
LCNF project funding	The original project budget was £1,490k. final cost of the project of £1,470k
Project objectives	The project aimed to ▪ trial and develop procedures to install low voltage (LV) monitoring without customer interruptions on 200 low voltage networks, ▪ increase understanding of current low voltage network performance, ▪ develop detailed electrical models to assess hosting capacity and potential network solutions under increasing penetrations of low carbon technologies (LCTs), ▪ across the whole low voltage (LV) and high voltage (HV) network, improve existing estimates of load, and develop a tool to estimate future loads and capacity headroom.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	*The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits not specifically quantified.* **Evidence:** Whilst the project has not directly facilitated any LCT connections it has supported and validated the business decision made by Electricity North West to move to a 'connect and manage' approach (with monitoring) for connection of clusters of small-scale embedded generation such as PV. This is a quicker and more cost effective method of connection than previous. As stated in the closedown report: "The project has built the foundations for future deployment of LV monitoring – making significant contributions to the questions of both how and when to monitor in the context of increased LCT uptake." **Reference:** ▪ Closedown report, June 2014

Has the potential to deliver net financial benefits to future and/or existing customers	-	*Evidence that the project is likely to deliver financial benefits in the long term (ED2 and beyond) to the majority of customers* **Evidence:** It was recognised in the closedown report that the focus of this project was on developing monitoring and learning to manage future network requirements, rather than to offset planned spending in the DPCR5 period. As such, the expectation of the revenue allowed for within the DPCR5 settlement that was likely to be saved as a result of the project was zero. However this project is the foundation for future LV monitoring and is expected to assist the connection of LCT uptake. **Reference:** ▪ Closedown report, June 2014
Has a Direct Impact on the operation of a DNO's Distribution System	4	*The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects. The project has a high likelihood of being replicated by other DNOs.* **Evidence:** Implementation was proposed via three routes: 1. Some of the monitoring in this project will be used from 2014 to 2017 for monitoring of LV networks in Manchester proposed for domestic heat pump installations in a partnership with the Japanese New Energy Development Organisation (NEDO). 2. Electricity North West intends to review its Code of Practice 303 on 'Installation, Maintenance and Removal of Monitoring and Measuring Equipment', based on developing expertise and processes. 3. The first implication was supporting and validating the business decision made by Electricity North West to move to a 'connect and manage' approach (with monitoring) for connection of clusters of small-scale embedded generation such as PV. **Reference:** ▪ Closedown report, June 2014
Generates knowledge that can be shared amongst all DNOs	5	*Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* ▪ Presented at 3 LCNF conferences & ENWL quarterly newsletters. ▪ Won a Best Smart Grid Technology award in 2012. ▪ Workshops with ENWL & University partner. ▪ Several Manchester University published papers. ▪ Dissemination event after close-out in Oct 14 **References:** ▪ http://www.enwl.co.uk/about-us/the-future/lcnf-tier-1-nia/low-voltage-network-solutions ▪ slides from http://www.enwl.co.uk/about-us/the-future/general-information/events-calendar

Focuses on network methods that are at the trialling stage	**2**	*Parts of the solution moved to* TRL7 (system prototype demonstration in operational environment) Parts *of solution remain at TRL 5.* **Evidence:** Different elements are at different TRL levels: ▪ Monitoring deployment was actually at TRL 6, moving towards TRL 7 by the end of the project ▪ The modelling of real networks reached TRL 5 ▪ Creation of Electricity North West's Future Capacity Headroom Model for future estimates of load on the secondary network. This reached TRL 7 The project helps improvements to the Load Allocation estimates of load on the secondary network. This enabled TRL 8 – but on a separate project **Reference:** ▪ Closedown report, June 2014

Demonstrating the Benefits of Monitoring LV Network with Embedded PV Panels and EV Charging Point

Project Title	**Demonstrating the Benefits of Monitoring LV Network with Embedded PV Panels and EV Charging Point**
Tier	**1**
DNO	**SSE**
Status	**Complete**
LCNF project funding	**£320,000**
Project objectives	This project introduced distribution substation monitoring to obtain detailed and accurate current, voltage, power and directional energy usage data, and to develop an understanding of how DNOs might pursue such deployments in the future using monitoring devices installed at substations. It provided the opportunity to monitor the LV feeder circuit to which SSE's low carbon homes are connected to gain insight into the impact on the low voltage network. Consideration was given to the monitoring requirements of the Low Carbon Networks Fund (LCNF) Tier 2 New Thames Valley Vision1 (NTVV) project so that monitoring can be deployed with certainty on a larger scale through this project.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits not specifically quantified.* **Evidence:** Through the project, data analysis from the substation monitoring showed that showed there is capacity for additional connection of around 30 EVs on the feeder to which the low carbon homes are connected, but did not enable quantification of additional PV which could be connected. Therefore, the project has potential to facilitate the connection of low carbon demand. Carbon benefits are not specifically quantified. **References:** ▪ Demonstrating the Benefits of Monitoring LV Networks with embedded PV Panels and EV Charging Point; Close down report; Feb 2013.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Compelling evidence that the project is highly likely to deliver significant financial benefits in the long term (ED2 and beyond) to selected group of customers.* **Evidence:** The closedown report details the financial benefits in Table 11. The main financial benefit for customers is around the connection of new low carbon technology. Benefit would therefore mainly be for customers wishing to connect new generation. **References:** ▪ Demonstrating the Benefits of Monitoring LV Networks with embedded PV Panels and EV Charging Point; Close down report; Feb 2013.
Has a Direct Impact on the operation of a DNO's Distribution System	**5**	**Assessment:** *The project has been / is ready to roll out into BAU and is being used in an ongoing tier 2 project). Other DNOs have included the project in their business plans.* **Evidence:** It is the outcome of the Tier 2 'New Thames Valley Vision' project that is expected to directly influence SSEPD and other DNOs' approach to business as usual. The findings from this project are being fed directly into the Tier 2 New Thames Valley Vision Project. Specifically this project proved safety aspects of fitting monitoring equipment into live distribution substations and enabled NTVV to progress with substation monitoring to the time line necessary for the provision of data. The project also highlighted the high cost of monitoring and installation and initiated "price challenges" on innovation via the EiC. Early outcomes indicate that monitoring costs can be reduced from £5000 to £1000 per installation. The closedown report states: It is noted that other DNOs (ENWL in particular) have already procured equipment configured by manufacturers on this project for deployment for business as usual activities. This is considered business as usual medium scale deployment. **References:** ▪ Demonstrating the Benefits of Monitoring LV Networks with embedded PV Panels and EV Charging Point; Close down report; Feb 2013 & SSE Questionnaire response

Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** The closedown report contains Appendix **I** – Specification for Substation LV Monitoring Equipment. SSEPD has already shared learning from this project with other DNOs via one-to-one site visits, including demonstrations of data transfer capabilities. One-to-one visits were arranged with UK Power Networks, Scottish Power, and Electricity North West (ENW). The key findings have been presented at the LCNF Conference in Cardiff (October 2012). **References:** ▪ Demonstrating the Benefits of Monitoring LV Networks with embedded PV Panels and EV Charging Point; Close down report; Feb 2013.
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to TRL9, or commercial solution proven in operational environment.* **Evidence:** Table 7 in the closedown report shows that all four project components have been moved to (or remain at) at TRL9. **References:** ▪ Demonstrating the Benefits of Monitoring LV Networks with embedded PV Panels and EV Charging Point; Close down report; Feb 2013.

Suburban PV Impact

Project Title	**Suburban PV Impact**
Tier	**1**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£100,000**
Project objectives	The objective of the project was to monitor the profile of eight selected substations or individual feeders in areas where PV panels have already been installed or are expected to be installed. The following aspects would be explored: ▪ How to measure and capture voltage, current, harmonic, real and reactive power data on a range of distribution assets in suburban areas. ▪ How to install equipment safely with minimal or no interruption of supply. ▪ How often the network characteristics need to be monitored (for example 1min, 5min, 15min). ▪ How we can interrogate the large amounts of data generated to highlight significant network issues created by the installation of PV panels. ▪ What the effect is of installing large numbers of PV panels on the LV network.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits not specifically quantified.* **Evidence:** An output of the project is that WPD's existing design policies and software tools have been amended to allow the connection of a further 20% solar PV on multiple LV properties. This is due to the measured diversity and lower than expected kW outputs. This shows that the project has helped facilitate the connection of low carbon generation. The carbon benefits are not specifically quantified. **References:** ▪ Assessing Solar Panel Implications for Networks; Closedown report; January 2014.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Inferred that the project is likely to deliver financial benefits in the long term to a selected group of customers.* **Evidence:** There is the potential for customers wishing to install solar PV to benefit from the additional connection availability. The closedown report does specifically cite this as a benefit and does not indicate whether these are likely to be short or long-term, although the connection of renewable energy generation is likely to bring longer term benefits to the selected group of customers who do so. The closedown report stated that it was possible to install all monitoring equipment with no interruptions to customers. **References:** ▪ Assessing Solar Panel Implications for Networks; Closedown report; January 2014.
Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The closedown report states that "LV monitoring will continue to be rolled out to substations which are deemed to be of strategic importance or have the potential to operate load patterns which fall outside of a template approach. LV monitoring technologies will be deployed using best practise from the LV Sensors report. Voltage and current sensors avoiding Customer Interruptions and Customer Minutes Lost are not part of our Business as Usual for all new projects." There is no evidence that other DNOs have implemented in their business plans. **References:** ▪ Assessing Solar Panel Implications for Networks; Closedown report; January 2014.

Generates knowledge that can be shared amongst all DNOs	**3**	**Assessment:** *A learning dissemination event or webinar was held but there are no specific replication reports.* **Evidence:** The learning from this project has been shared with other DNOs through the following routes: ▪ The project was presented on at both LCN Fund conferences 2012 and 2013. ▪ This (and other complementary projects) was presented on during a LV network monitoring event hosted at Leicester space station, attended by over 100 people including all UK DNOs. ▪ The full closedown report was produced detailing the key knowledge generated. ▪ The data from this project is available to other UK DNOs for their own analysis and comparison. There are no specific replication reports easily accessible. It is not clear the format of data available from the DNO. **References:** ▪ Assessing Solar Panel Implications for Networks; Closedown report; January 2014.
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment.* **Evidence:** The project application noted the solution as TRL 7-8. The LV monitoring element of the project is now continuing to be rolled out to substations, so can be deemed to be at TRL9. **References:** ▪ Assessing Solar Panel Implications for Networks; Closedown report; January 2014. ▪ First Tier LCN Project Registration.

Validation of Photovoltaic (PV) Connection Assessment Tool

Project Title	**Validation of Photovoltaic (PV) Connection Assessment Tool**
Tier	**1**
DNO	**UKPN**
Status	**Complete**
LCNF project funding	**£367,000**
Project objectives	The project planned to implement clear policy guidelines advising planners when further investigations might be necessary before connecting large clusters of solar panels to the electricity network. The project studied requests for photovoltaic (PV) connections in concentrated areas, like housing estates, so the DNO could develop a draft policy. They are now validating those guidelines. Project objectives were to: ▪ Monitor PV clusters to understand their impact on the low voltage network. ▪ Explore whether PV output information, held by installers, could be used by network operators. ▪ Investigate innovative solutions which can be applied to address network constraints. ▪ Validate planning assumptions in the DNO's draft connection assessment tool and develop an approved policy to provide more cost effective network interventions.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits not specifically quantified.* **Evidence:** This project focuses on understanding the impact of clusters of photovoltaic generation on the distribution network and validating the photovoltaic (PV) connection assessment tool that the DNO developed (i.e. validating the planning assumptions in the draft connection assessment tool). The next step was then to develop an approved policy to provide more cost effective network interventions. The data is used by the DNO to improve their connection assessment tools and should help to facilitate connection of low carbon generation. The project closedown report shows that there are a number of benefits for the connection of PV application, such as reduced processing time, customers being able to connect more PV without having to pay for network reinforcement and new PV schemes that would traditionally require network reinforcement being more feasible. Carbon benefits are not specifically quantified. **References:** ▪ Overview: Validation of PV Connection Assessment Tool – Nov 2013. ▪ Validation of Photovoltaic (PV) Connection Assessment Tool; Closedown Report; 13 March 2015

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Indication that the project is likely to deliver financial benefits in the long term to a selected group of customers.* **Evidence:** Stakeholder benefits are listed as: ▪ Enabling more renewable generation on the network without conventional reinforcement. ▪ Allowing householders and businesses to benefit from generating their own energy. ▪ Understanding the network's performance when more renewable energy is connected. ▪ Developing a pragmatic connection assessment approach covering both innovative solutions and more traditional network reinforcements. ▪ Establishing whether low voltage monitoring can be minimised by using PV installers' data. The final report notes that customers will benefit from reduced processing costs for their application. There are also likely to be financial benefits for customers who wish to connect renewable energy generation. The overview leaflet does not indicate whether these are likely to be short or long-term, although the connection of renewable energy generation is likely to bring longer term benefits to the selected group of customers who do so. **References:** • Overview: Validation of PV Connection Assessment Tool – Nov 2013. • Validation of Photovoltaic (PV) Connection Assessment Tool; Closedown Report; 13 March 2015.
Has a Direct Impact on the operation of a DNO's Distribution System	4	**Assessment:** *The project has been /is ready to roll out into BAU.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The overview leaflet indicates that initial data was being used to find ways to improve the DNO's connection assessment tools. The final report states that the project delivered a validated and pragmatic connection assessment approach, comprising a formal design procedure and an improved tool that UK Power Networks will adopt into business as usual and share with other GB DNOs during 2015. It is noted that further work is needed to enable adoption of smart solutions into business as usual. The key message is that UK Power Networks will adopt a new engineering design procedure and improved voltage rise assessment tool into BAU during 2015. It is not clear whether other DNOs have adopted the procedure developed. **References:** ▪ Validation of Photovoltaic (PV) Connection Assessment Tool; Closedown Report; 13 March 2015. ▪ Overview: Validation of PV Connection Assessment Tool – Nov 2013.

Generates knowledge that can be shared amongst all DNOs	**4**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *There is no evidence of a learning dissemination event or webinar.* **Evidence:** A design specification exists, as the closedown report states that a copy of the design procedure and tool is available to other GB DNOs on request. Some basic details can be found in the closedown report. There is no indication that a learning or dissemination event was held **References:** ▪ Validation of Photovoltaic (PV) Connection Assessment Tool; Closedown Report; 13 March 2015. ▪ http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-1-projects/validation-of-pv-connection-assessment-tool/
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment.* **Evidence:** The first tier pro-forma notes the TRL as 7-8. As the procedure is noted as developed and moving into BAU in the closedown report, the solution is considered to have moved to TRL 9, although this is not specifically stated. **References:** ▪ Validation of Photovoltaic (PV) Connection Assessment Tool; Closedown Report; 13 March 2015. ▪ Validation of Photovoltaic (PV) connection assessment tool; First Tier Pro-forma.

Early learning of LV network impacts from estate PV cluster

Project Title	**Early learning of LV network impacts from estate PV cluster**
Tier	**1**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£20,000**
Project objectives	The project sought to test the accuracy of present modelling through real life voltage and load measurements on one feeder of an LV system. The objectives were to seek early data on behaviour of multiple densely populated PV units on a single estate and to test the validity of the traditional network modelling that indicated that no more than 12 units could be accommodated. Such data will benefit modelling with consequential impact on seeking to reduce reinforcement cost for future connection of multiple LV PV installations.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	3	**Assessment:** *The project clearly facilitates one of the carbon benefits: Defer asset reinforcement.* **Evidence:** The project gathered data that should have an impact on reducing reinforcement costs for future connection of multiple LV PV installations. **References:** ▪ Early learning of LV network impacts from estate PV cluster; Closedown report; May 2013.
Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Little or no evidence on the financial benefit the project will have for customers however they would be expected to be in relation to reduced DUoS cost.* **Evidence:** The financial benefits to customers are not specifically set out in the project closedown report. **References:** ▪ Early learning of LV network impacts from estate PV cluster; Closedown report; May 2013.

Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects. The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The project closedown report does not outline progress for bringing the solution into BAU. However, the outputs from the project are used in the LV Network Templates Tier 2 project. **References:** ▪ Early learning of LV network impacts from estate PV cluster; Closedown report; May 2013.
Generates knowledge that can be shared amongst all DNOs	**2**	**Assessment:** *The only replication information available is in the closedown report.* **Evidence:** The key learning and output from this project is the closeout report and its appendix. Appendix A is not available in the downloadable document. There is no evidence of a learning or dissemination event. **References:** ▪ Early learning of LV network impacts from estate PV cluster; Closedown report; May 2013.
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to operational environment* **Evidence:** TRL is not outlined in the project registration pro-forma and is not specifically discussed in the closedown report. There is therefore not enough evidence to determine whether the solution has progress with regard to TRL. However the key learning is identified as being to enable reassessment of the LV planning assumptions and design for DG and hence is being used in an operational environment. The data has been incorporated into the LV templates study. **References:** ▪ Early learning of LV network impacts from estate PV cluster; Closedown report; May 2013.

Low Voltage (LV) Network Modelling and Analysis Environment

Project Title	**Low Voltage (LV) Network Modelling and Analysis Environment**
Tier	**1**
DNO	**SSE**
Status	**Complete**
LCNF project funding	**£320,000**
Project objectives	In order to evaluate the effect of embedded generation and low carbon devices on the HV/LV network, this project sought to demonstrate in a working environment a prototype capable of: (1) recording and reporting on the deployment of low carbon devices; (2) modelling the impact of deployed low carbon devices; (3) managing multiple scenarios of low carbon LV networks; (4) performing power analysis of these networks that includes distributed generation and load profiles. A comparison of different power analysis engines is included in this project.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** The project has proven that it is possible to provide the required functionality and has highlighted specific areas that need additional work to increase the automation, improve accuracy and has laid the foundations for the complete system This project has shown the initial benefits of modelling and SSEPD would now place a high value on information systems with network analysis capabilities. The prototype is intended to help understanding of the impact of low carbon technologies on LV networks, which will allow DNOs to accurately model low voltage networks in a reduced timeframe and hence decrease the chance of the network becoming a barrier to low carbon technologies. **References:** ▪ Low Voltage (LV) Network Modelling and Analysis Environment; Closedown report; February 2013.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Little or no evidence that the project will deliver financial benefit to customers.* **Evidence:** The main benefits and knowledge delivered by the project relate to learning around the practical issues and considerations associated with integration of different systems to create a 'low voltage network modelling environment'. (Financial) benefits to customers are not specifically outlined in the project closedown report. Learning from this project has fed into the Tier 2 New Thames Valley Vision project, which is expected to have customer benefits. **References:** ▪ Low Voltage (LV) Network Modelling and Analysis Environment; Closedown report; February 2013.
Has a Direct Impact on the operation of a DNO's Distribution System4	4	**Assessment:** *The project outputs are utilised in later LNCF projects.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The closedown report states that in order to move the system forward and ultimately end up in business as usual, additional development work is required. The project identified the appropriate choice of power analysis tool to be used such that the impact of LCTs on the LV network could be appropriately assessed. Learning from the project fed into NTVV which will refine the software. **References:** ▪ Low Voltage (LV) Network Modelling and Analysis Environment; Closedown report; February 2013. ▪ Questionnaire response
Generates knowledge that can be shared amongst all DNOs	2	**Assessment:** *The only replication information available is in the closedown report.* **Evidence:** The tables in section 11 of the closedown report list all physical components and knowledge required to replicate the outcomes of this project. Contact email is provided for further information, although no specific replication reports are mentioned. There is no evidence of a dissemination event. **References:** ▪ Low Voltage (LV) Network Modelling and Analysis Environment; Closedown report; February 2013.

Focuses on network methods that are at the trialling stage	**2**	**Assessment:** *Solution moved to TRL6 (technology demonstrated in relevant environment), or commercial solution demonstrated in restricted environment* **Evidence:** TRL 6 in the first tier project pro-forma. The closedown report states that initial figure was difficult to determine and that the justification discussed in the report puts the TRL at 6 upon completion of this Tier 1 project. **References:** ▪ Tier 1 project pro-forma. ▪ Low Voltage (LV) Network Modelling and Analysis Environment; Closedown report; February 2013.

Low Voltage Protection and Communications (LV PAC)

Project Title	**Low Voltage Protection and Communications (LV PAC)**
Tier	**1**
DNO	**ENW**
Status	**Complete**
LCNF project funding	**£750,000**
Project objectives	The project objective was to deliver a new set of protection functions which would allow greater protection of the future LV networks, the method to calculate the settings to be applied to the different network configurations and a communications system to allow these to be altered remotely.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	3	**Assessment:** *The project is expected to defer asset reinforcement.* **Evidence:** This purpose of this project is to further develop and implement the advanced protection and communications required to meet the LCT requirements of the LV networks of the future. This will help to prevent the overloading of assets. **References:** ▪ Low voltage protection and communications; Close down report; June 2015. ▪ Tier 1 pro-forma.
Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Evidence that the project is likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment).* **Evidence:** The benefits of the project would be greater protection and control functionality for LV networks, particularly looking at catering for the expected increase in LCT installation. There are benefits to customers in terms of preventing loses in supply. However, the financial benefits have not specifically been set out. **References:** ▪ Low voltage protection and communications; Close down report; June 2015.

Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** Some of the elements of the project were transferred to another BAU project. The communications routes developed as part of this project were used to remotely talk to all the Weezap (LV circuit breaker) and Lynx (LV switch) devices being deployed as part of the Second Tier project, Smart Street. The protection algorithms were deployed in selected devices as part of Smart Street. **References:** ▪ Low voltage protection and communications; Close down report; June 2015.
Generates knowledge that can be shared amongst all DNOs	**2**	**Assessment:** *The only replication information available is in the closedown report.* **Evidence:** The closedown report states that all of the protection algorithms and communications protocols developed as part of LV PAC will be commercially available on the Weezap and Lynx platforms. There do not appear to be any other replication materials and there is no evidence of a dissemination event. **References:** ▪ Low voltage protection and communications; Close down report; June 2015.
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Moved from TPL 6 to TRL 9* actu*al system proven in operational environment* **Evidence:** TRL 6 in the tier 1 project pro-forma. TRL has not been discussed in the project closedown report. However, the key objective of the project was demonstrated enhanced protection functionality which can be applied to the Weezap devices. This was done and the solution is being used in ongoing projects. Therefore, the solution can be considered to be TRL9– system demonstrated in operational environment. **References:** ▪ Low voltage protection and communications; Close down report; June 2015. ▪ Tier 1 pro-forma.

Distribution Network Visibility

Project Title	Distribution Network Visibility
Tier	**1**
DNO	**UKPN**
Status	**Complete**
LCNF project funding	**£2,890,000**
Project objectives	The main aim of the project was to demonstrate the benefits of the smart collection, utilisation and visualisation of distribution network data. Areas addressed as part of the project: 1. Identifying the business units that would benefit from visualisation and analysis of the data, and defining the functionalities they would require to deliver these benefits. 2. Development of a visualisation application. 3. Trialling commercially available load flow to visualise dynamic load flows on distribution networks. 4. Maximise benefit from existing data sources. 5. Trial advanced monitoring sensors.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** The benefits referenced in section 5.1 of the closedown report, and on the project website, show that the project will facilitate and support the connection of new load and renewable generation. The project therefore facilitates the connection of low carbon generation. Carbon benefits are not specifically quantified. **References:** ▪ Distribution Network Visibility: LCN Fund Tier 1Close down Report; Dec-13. ▪ http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-1-projects/distribution-network-visibility/

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is highly likely to deliver financial benefits to the customers in London* **Evidence:** Section 5.1 of the closedown report outlines the benefits from the project and the potential benefits to businesses. These include the avoidance of network reinforcement, customer interruptions and asset replacement, as well as facilitating more efficient connection of low carbon generation. The benefits are stated on the website as: Clearer demand profiles to help plan network reinforcement schemes; Improved management of secondary substation ventilation; Better, more cost-effective application of maintenance policies; Support the connection of new load and renewable generation. The project therefore has a number of benefits for customers. These are likely to be a mix of short and longer term benefits. **References:** ▪ Distribution Network Visibility: LCN Fund Tier 1Close down Report; Dec-13. ▪ http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-1-projects/distribution-network-visibility/
Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** DNV software application was successfully developed and the application has been embedded into BAU within UKPN. The final report states "A production web-based application was successfully developed to implement a suite of visualisations and analysis tools for network data. This application has now been adopted business as usual by UK Power Networks as part of our corporate IT landscape and is being used by various business units." The project is not specifically used for any follow on projects however is a valuable source of system data for other UKPN projects such as Flexible Urban Networks (FUN) LV. The techniques used in the tool are applicable to other DNOS where system data is available. **References:** ▪ Distribution Network Visibility: LCN Fund Tier 1Close down Report; Dec-13.

Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist.* *These cover the main technical / commercial / stakeholder aspects as applicable.* *A learning dissemination event or webinar was held.* **Evidence:** Appendix E provides an overview of the reports issues on the project. These are not readily available on the website, but are available to other DNOs on request. There are ten reports on the DNV application, eight on network monitoring, four on real time power flow and five on RTU advanced features. A presentation on the project is available from the project website (dated November 2013) and presentations were given at the two of the LCNF annual conferences. **References:** ▪ Distribution Network Visibility: LCN Fund Tier 1Close down Report; Dec-13. ▪ http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-1-projects/distribution-network-visibility/
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment* **Evidence:** Software developed through the project has now been implemented as BAU in UKPN. Therefore, commercial solution has been developed and can be considered to be moved to TRL9. **References:** ▪ Distribution Network Visibility: LCN Fund Tier 1Close down Report; Dec-13.

Ashton Hayes Smart Village

Project Title	Ashton Hayes Smart Village
Tier	1
DNO	SPEN
Status	Closed
LCNF project funding	The original project cost was £200,000, whereas, the actual project expenditure was £141,436 (-30%).
Project objectives	Four objectives: ▪ To facilitate the connection of various micro generation technologies (wind, PV and CHP) and potentially electric vehicle (EV) charging point(s) on the LV network and its 11 kV feeders. ▪ To engage with the village and community to assist in the reduction and optimisation of total energy consumption to reduce carbon footprint. ▪ To improve the accuracy and granularity of total electricity consumption measurement by installing additional metering on the network at secondary substation feeder level and at renewable energy source(s) providing measurement of the gross generation embedded within the community. ▪ To introduce innovative and new techniques to introduce DSM capabilities aimed at assisting change in energy use related behaviours within residential homes and public properties.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand. The carbon benefits not specifically quantified* **Evidence:** Sample of findings: ▪ DSR: The scope for DSR is significant (around 7.5-10% of the total during peak hours) and will increase as buildings become more energy efficient. ▪ Network Model: LV data analysis showed that there was additional network capacity available, which was more than existing planning processes may assume, thus demonstrating that more renewable generation and low carbon technologies could be connected than conventional assessments would predict. ▪ Network Data: The amount of capacity available for generation can be estimated by considering the minimum voltages recorded during 24 hours or during daylight hours. More PV can connect compared to generation in general as it is guaranteed to only operate during daylight hours when

		the load is higher. ▪ RTTR of Transformer The pole mounted transformer (PMT) is probably not overloaded in winter even though the static rating indicates that it is. In summer, despite the load being lower and the transformer rating being higher than that indicated by the static rating, the transformer was overloaded. **References:** ▪ Close down report
Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is highly likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment)* The planned DSR trial was not achieved due to a delay in the role out of Smart Meters If the highest loading is during the coldest times of the year, upgrading a transformer that appears to be overloaded may not be required. This could save around £8,000 per transformer that is not replaced. Avoiding transformer upgrades is the main benefit assessed – but would need monitoring of each feeder to justify this. **References:** ▪ Close down report
Has a Direct Impact on the operation of a DNO's Distribution System	**5**	**Assessment:** *Parts of the project are utilised in later LNCF projects* Whilst not yet fully developed, the project has opened up new possibilities for new ways of working to be developed into a strategy with input from Tier 2 projects so that they can become Business As Usual. Much of the learning generated from engaging with the village residents in this project has influenced SPENs ED1 strategy for BaU Community / Stakeholder Engagement. **References:** ▪ Close down report ▪ Questionnaire response

Generates knowledge that can be shared amongst all DNOs	**3**	**Assessment:** *A range of dissemination events were held but there are no specific replication reports.* **Evidence:** Monitoring not always operational – a key finding Data shared with several universities for a range of separate projects. A range of other dissemination processes were used to raise awareness and pass on the knowledge gained from the project. These included: ▪ A 2011 CIRED paper 'Community Energy from Policy to Practice'7 helped raise awareness across the globe within the industry sector. The conference provided a useful venue to discuss the project and compare outcomes with similar work being carried out internationally. ▪ Data was used in the paper 'The Future for EVs: reducing network costs and hassle' for HCEV 2013. This was published November 2013. ▪ SPEN made a presentation to the Local Cheshire and Warrington IET branch. ▪ The project was a finalist in the IET Innovation Awards under the sustainability category. See Appendix C 'Dissemination Material' for the IET Award. ▪ Presentations were made at LCN Fund conferences and to Ofgem. ▪ The project was referenced at The Women's Engineering Society Conference, Harnessing the Energy, 'Why We Need Community Energy' Friday 4th October 2013 SPEN website address no longer valid **References:** ▪ Close down report
Focuses on network methods that are at the trialling stage	**4**	**Assessment:** **Evidence:** *The technical aspect of the solution remained at TRL8 (system complete and qualified).* The monitoring equipment utilised by this project was an established product used throughout the industry. However, until this and other LCNF projects it had not been utilised on LV networks to any great extent. With this project the monitoring systems performance was tested for this specific application. The TRL for the monitoring activities undertaken remained at 8 throughout this project. A TRL for community engagement is not appropriate as these activities involved human interaction and communication rather than a technology.

Hook Norton Low Carbon Community Smart Grid (Smart Hooky)

Project Title	**Hook Norton Low Carbon Community Smart Grid (Smart Hooky)**
Tier	**1**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£350,000**
Project objectives	Project scope and objectives (as per project registration form) were: ▪ To develop and explore customer engagement and incentive programmes. This aspect will include a small scale domestic demand response trial. ▪ To develop community data measurement and display capabilities (e.g. to ascertain the total electricity consumption of the village by installing measurement devices at various locations. Subsequently, to provide this and other relevant information back to the local community via a web portal/customer interface (which if successful, could then be used for other villages). ▪ To deploy Power Line Communications (PLC) technology at scale within the low voltage (LV) network, illustrating its potential capabilities for enabling smart grid end point measurement and data aggregation. ▪ To test and compare a variety of ‘off the shelf’ asset monitoring solutions for HV/LV pole-mounted and ground-mounted substations. The quality of the products will be assessed, alongside the installation methods. ▪ To test and demonstrate a miniature smart grid telecommunications network (with multiple technologies) that will enable both local and remote network visibility. ▪ To explore the changes that could be made to a network control system for enabling simple forms of Low Voltage (LV) network monitoring and management.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits not specifically quantified.* **Evidence:** The project has resulted in improved visibility of the network, which will give greater confidence to the connection of additional loads and generation on the network. Additional visibility has been created through the web portal (www.smart-hooky.net (website no longer live)) giving greater awareness of energy issues to the residents utilising the tool. The project should therefore help to facilitate the connection of low carbon generation and also other carbon benefits from substation monitoring. The carbon benefits are not specifically quantified. **References:** ▪ Smart Hooky; Closedown report; Dec-13.
Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Evidence that the project is highly likely to deliver financial benefits to the majority of customers. However, these benefits may be comparatively short term.* **Evidence:** The closedown report cites reduced bills as a financial benefit to customers from the project. Other benefits include security of future supply and improved education around energy efficiency. Therefore, the majority of customers could benefit, although it is not clear whether benefits will be shorter or longer-term. **References:** ▪ Smart Hooky; Closedown report; Dec-13.
Has a Direct Impact on the operation of a DNO's Distribution System	4	**Assessment:** *The project has been /is ready to roll out into BAU.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The closedown report states that monitoring will continue to form an integral part of trial projects, moving more into business as usual as the costs reduce and additional business applications emerge. **References:** ▪ Smart Hooky; Closedown report; Dec-13.

Generates knowledge that can be shared amongst all DNOs	**3**	**Assessment:** *A learning dissemination event or webinar was held but there are no specific replication reports* **Evidence:** The information gained from the Smart Hooky project has been shared at a number of forums including the 2012 and 2013 Low Carbon Network Fund Conference. In February 2013 an event was run at Hook Norton Brewery to showcase the findings from the project and allow delegates to view actual installations. The event was attended by about 20 people including representatives from energy charities, universities and 4 other network operators. There is no evidence of specific dissemination reports. **References:** ▪ Smart Hooky; Closedown report; Dec-13.
Focuses on network methods that are at the trialling stage	**5**	**Assessment:** *Solution moved to TRL9 (actual system proven in operational environment), or commercial solution proven in operational environment.* **Evidence:** The project application noted the solution as TRL 5-8. The LV monitoring element of the project is now continuing to be rolled out to substations - so can be deemed to be at TRL9. **References:** ▪ Smart Hooky; Closedown report; Dec-13 & First Tier LCN Project Registration.

Interconnection of WPD and NGC SCADA

Project Title	**Interconnection of WPD and NGC SCADA**
Tier	**1**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£79,000**
Project objectives	This objective of this project was to establish a real time link between the SCADA systems operated by National Grid and Western Power Distribution such that data on either system can be viewed on the other in real time. The objectives were to: ▪ Establish the link ▪ Establish access to the data and methods of viewing the data ▪ Establish the security measures required to ensure the security of the link to both of the systems against cyber-attack.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* *The carbon benefits not specifically quantified.* **Evidence:** DNOs have real time visibility of EHV and significant HV connected distributed generation but NGC do not. As the amount of DG increases it will become important for NGC to have real time visibility of their operation to enable them to undertake system balancing and manage power flow. With further research, an increased benefit to NGC could be delivered in terms of visibility of the end to end electricity system and deliver reduced system risk to the UK as a whole. However, carbon benefits of the project are not clearly defined or quantified. **References:** ▪ Interconnection of WPD and NGC SCADA Systems; Closedown report; March 2013.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *When this level of information is needed the project learning will facilitate the connection of DG.* **Evidence:** The closedown report does not clearly outline any benefits to customers however it is to be expected that if the amount of DG continues to increase NGC may require real time visibility of the large and medium DG and hence this learning will be valuable. **References:** ▪ Interconnection of WPD and NGC SCADA Systems; Closedown report; March 2013.
Has a Direct Impact on the operation of a DNO's Distribution System	**1**	**Assessment:** *There is further research required on the solution before the project has potential for replication.* **Evidence:** As further research is required, at the time of the project closedown report, there were no plans to with NGC to deploy ICCP links in the short term. The DNO planned to continue a dialogue with NGC as to the role the link will play in the future as part of the on-going review of DNO/NGC data sharing processes. **References:** ▪ Interconnection of WPD and NGC SCADA Systems; Closedown report; March 2013.
Generates knowledge that can be shared amongst all DNOs	**2**	**Assessment:** *The only replication information available is in the closedown report.* **Evidence:** The closedown report states that it is intended to form the core of the knowledge dissemination process. There is no evidence of a dissemination event. **References:** ▪ Interconnection of WPD and NGC SCADA Systems; Closedown report; March 2013.
Focuses on network methods that are at the trialling stage	**2**	**Assessment:** *Solution has not progressed with regard to technology level, or has not progressed with regard to a commercial arrangement.* **Evidence:** The closedown report states: "At initiation of this trial, the ICCP link functionality was at TRL 7. As further work is required to assess the use of the link with multiple connections, it is considered that the TRL is unchanged." **References:** ▪ Interconnection of WPD and NGC SCADA Systems; Closedown report; March 2013.

E.11 Voltage Control

Low Voltage Integrated Automation (LoVIA)

Project Title	Low Voltage Integrated Automation (LoVIA)
Tier	1
DNO	ENW
Status	Complete
LCNF project funding	£600,000
Project objectives	The scope of LoVIA is the deployment of two trial systems on the ENWL low voltage network the objectives of which are to demonstrate the application and integration of new distribution system equipment for the purposes of coordinated voltage control. LoVIA will provide the foundations of a future coordinated LV network voltage control platform and facilitate automated low voltage network operation.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	4	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** This project has shown that an integrated and coordinated voltage control system can be deployed at distribution substations to provide more refined management of voltages on the LV systems (and realise significant voltage headroom) to support the connection of increased low carbon technology. **References:** ▪ Low Voltage Integrated Automation; Close down report; December 2013.
Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Indication that the project is likely to deliver financial benefits to customers. However, the financial benefits and the scale/term of these are not set out.* **Evidence:** The benefits to customers described in the report is in terms of voltage quality delivered. Financial benefits are not specifically set out. **References:** ▪ Low Voltage Integrated Automation; Close down report; December 2013.

Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** Electricity North West plan to carry out a detailed review of the LV planning codes of practice following all of the projects that are being undertaken. This should result in more comprehensive guidance with a wider portfolio of solutions to cater for different network conditions which can be used as part of business as usual. The project solution is not yet implemented as BAU. However, outputs from the project are being used in the follow-on Tier 2 project 'Smart Street'. The smart joint developed in the project is a BAU technique for establishing means of voltage measurement on LV feeders at a point remote from a feeding substation. To-date 200 smart joints have been deployed. **References:** ▪ Low Voltage Integrated Automation; Close down report; December 2013.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist / are available on request.* *A learning dissemination event or webinar was held.* **Evidence:** As a direct outcome of this project Electricity North West has produced and made publicly available: ▪ The algorithm used to adjust the set point ▪ Communications architecture for the LoVIA system This technical information is contained in the closedown report and in the appendices and is available for download via the Electricity North West website. Electricity North West has presented this project at two LCNF annual conferences. **References:** ▪ Low Voltage Integrated Automation; Close down report; December 2013. ▪ http://www.enwl.co.uk/about-us/the-future/nia-lcnf-tier-1/lovia

Focuses on network methods that are at the trialling stage	**3**	**Assessment:** *Solution moved to TRL7 (system prototype demonstrated in operational environment), or commercial solution demonstrated in operational environment.* **Evidence:** TRL 6 in the tier 1 project pro-forma. TRL is not discussed in the project closedown report. However, the key objective of the project was to field trial an integrated voltage control scheme to understand its potential to help with anticipated future challenges associated with the connection of low carbon loads. The trials were successfully carried out and the learning has been taken into Smart Street, so the technology can therefore be considered to be at least at TRL7 – system prototype demonstrated in operational environment. **References:** ▪ Low Voltage Integrated Automation; Close down report; December 2013. ▪ Tier 1 pro-forma

Voltage Management on LV Busbars

Project Title	**Voltage Management on LV Busbars**
Tier	**1**
DNO	**ENW**
Status	**Complete**
LCNF project funding	**£485,000**
Project objectives	This project sought to deploy a range of voltage management technologies and techniques across 15 distribution substations. They were assessed in terms of their ability to effectively regulate line voltage in real-time in a safe and economical manner. In addition to voltage management, the ability of compensating devices to correct for poor power factor was assessed. The focus of the project was to learn about techniques to regulate voltage and avoid future reinforcement requirements, rather than to offset planned spending in the DPCR5 period.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** This project has successfully shown that through the use of techniques such as distribution transformers with on load tapchangers and LV capacitors, voltages can be effectively managed on the LV systems to support the connection of increased low carbon technology. **References:** ▪ Voltage Management on Low Voltage Busbars; Closedown report; December 2013.

Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Evidence that the project is likely to deliver financial benefits to the majority of customers, but that these benefits are comparatively short term (e.g. associated with asset replacement deferment).* **Evidence:** Financial benefits to customers are not specifically laid out in the closedown report. However, the closedown report does make reference to a benefit from use of voltage optimisers (powerPerfector Plus), which are marketed as a device to reduce voltage thereby delivering reduced energy to a customer and reducing energy bills. Therefore, there is likely to be financial benefit to customers in terms of reduced energy bills. There is also likely to be some benefits in terms of the connection of new low carbon technologies, although this financial benefit is not specifically set out. **References:** ▪ Voltage Management on Low Voltage Busbars; Closedown report; December 2013.
Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project has been /is ready to roll out into BAU or outputs are utilised in later LNCF projects.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The closedown report notes that this project has highlighted a number of challenges associated with the transition of learning outcomes into business as usual activities. Electricity North West recognises that successful transfer to BAU will require internal briefing and dissemination. To facilitate this, the Future Networks Team of Electricity North undertakes regular project briefings will key personnel across the business. They also planned to carry out a detailed review of the LV planning codes of practice. The learnings from the project were fed into the Smart Street Tier 2 project. **References:** ▪ Voltage Management on Low Voltage Busbars; Closedown report; December 2013.

Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist / are available on request.* *A learning dissemination event or webinar was held.* **Evidence:** As a direct outcome of this project Electricity North West has produced and made publicly available: 1. Detailed Operational Procedures for all devices 2. Settings for the tap change control relay (TAPCON 230) 3. A specification for the LV capacitors These documents are referred to in the appendices of the closedown report and documentation is available for download via the Electricity North West Future Networks website. Electricity North West has presented this project at three LCNF annual conferences. **References:** ▪ Voltage Management on Low Voltage Busbars; Closedown report; December 2013. ▪ http://www.enwl.co.uk/about-us/the-future/nia-lcnf-tier-1/low-voltage-busbars
Focuses on network methods that are at the trialling stage	**3**	**Assessment:** *Solution moved to TRL7 (system prototype demonstrated in operational environment), or commercial solution demonstrated in operational environment.* **Evidence:** TRL 5 in the tier 1 project pro-forma. TRL has not been discussed in the project closedown report. However, the project has investigated through trial application a range of voltage management technologies and techniques across 15 distribution substations. The technology can therefore be considered to be at least at TRL7 – system prototype demonstrated in operational environment. **References:** ▪ Voltage Management on Low Voltage Busbars; Closedown report; December 2013. ▪ Tier 1 pro-forma

Voltage Control System Demonstration Project

Project Title	**Voltage Control System Demonstration Project**
Tier	**1**
DNO	**WPD**
Status	**Complete**
LCNF project funding	**£525k**
Project objectives	This project aimed to address the issue of fluctuations seen in long distribution lines in a rural area with DG (in the form of Wind Turbines) connected. The objective was to determine the effectiveness of D-SVCs (Static VAr Compensator for Distribution Networks) as a system to control voltage on 11kV rural networks. Phase 1 comprised the testing of a single D-SVC to provide feed-back for the development of a D-VQC (Voltage and Reactive Power (Q) Control System). The planned Phase project to optimise multiple D-SVCs across two primary substations did not take place under this project.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	**4**	**Assessment:** *The project clearly facilitates the connection of low carbon generation or demand.* **Evidence:** The project closedown report states that one of the key performance characteristics of the D-SVC was its ability to reduce the voltage of the line in real terms while the generator was exporting power. The ability of the D-SVC to do this would allow more generation to be connected to rural 11kV networks where voltage rise from the generator is usually the limiting factor. **References:** ▪ Voltage Control System Demonstration Project; Close-Down Report; September 2014.
Has the potential to deliver net financial benefits to future and/or existing customers	**-**	**Assessment:** *Indication that the project is likely to deliver financial benefits to customers. However, the financial benefits and the scale/term of these are not set out.* **Evidence:** The financial benefits to customers are not specifically set out in the project closedown report. There are likely to be some benefits to customers seeking to connect new generation, but this is not detailed. **References:** ▪ Voltage Control System Demonstration Project; Close-Down Report; September 2014.

Has a Direct Impact on the operation of a DNO's Distribution System	**4**	**Assessment:** *The project learning is utilised in a later NIA project.* *The project has a high likelihood of being replicated by other DNOs.* **Evidence:** The closedown report states that the solution has the prospective to be implemented in business as usual either in part or full. However, it does require testing in Phase 2. The outputs in the project feed into the NIA project SVC demonstrator. **References:** ▪ Voltage Control System Demonstration Project; Close-Down Report; September 2014.
Generates knowledge that can be shared amongst all DNOs	**5**	**Assessment:** *Specific replication report(s) exist / are available on request.* *A learning dissemination event or webinar was held.* **Evidence:** Section 12 of the project closedown report provides information to help facilitate replication. It states that design documents and specifications for the equipment developed for this project are available on request and provides points of contact for this. The project was reported on during both the 2012 and 2013 Low Carbon Network Fund Conferences. **References:** ▪ Voltage Control System Demonstration Project; Close-Down Report; September 2014.
Focuses on network methods that are at the trialling stage	**3**	**Assessment:** *Solution moved to TRL7 (system prototype demonstrated in operational environment), or commercial solution demonstrated in operational environment.* **Evidence:** TRL 7 in the Tier 1 project registration pro-forma. TRL is not specifically mentioned in the project closedown report. It is considered that the technology is at least at TRL 7 at the end of the project (system prototype demonstration in operational environment). **References:** ▪ Tier 1 project registration pro-forma. ▪ Voltage Control System Demonstration Project; Close-Down Report; September 2014.

Digital Substation Platform

Project Title	**Digital Substation Platform**
Tier	**1**
DNO	**SSE**
Status	**Complete**
LCNF project funding	**£360k**
Project objectives	The scope of this project is to deploy a trial system with protection and ANM functionality together on the same hardware platform in a test environment i.e. the PNDC. Objectives: 1 - Demonstration of data integration and interfacing between the two platforms; 2 - Simulated control of a generator to allow the management of voltage on the network; 3 - Protection of primary assets using Locamation's suite of protection algorithms; 4 - Definition of a methodology for deeper integration in Phase 2.

Assessment

Criteria	Score (1-5)	Overview of assessment, sources of evidence and comments
Accelerates the development of a low carbon energy sector	3	**Assessment:** *The project clearly facilitates one of the carbon benefits: Provide reactive power services/ Provide frequency response service/Defer asset reinforcement.* *The carbon benefits not specifically quantified.* **Evidence:** A learning outcome of the project was 'Simulated control of a generator to allow for the management of voltage on the network'. This showed that voltage management was possible for both Real and Reactive power using generation control. **References:** ▪ Digital Substation Platform; Closedown report; April 2015.

Has the potential to deliver net financial benefits to future and/or existing customers	-	**Assessment:** *Little or no evidence that the project will deliver immediate benefit to customers, although these may occur in future.* **Evidence:** Financial (or other) benefits to customers not discussed in the project closedown report. The project outputs feed into the NIA project. So customer benefits are anticipated at a later point in time. **References:** ▪ Digital Substation Platform; Closedown report; April 2015.
Has a Direct Impact on the operation of a DNO's Distribution System	2	**Assessment:** *The project has demonstrated functionality in a test environment which may be utilised in later NIA projects.* **Evidence:** The project has undertaken an assessment of the qualitative benefit in using digital protection systems, so that further digital systems can be installed using the same hardware, This has helped progress and inform the future IT architecture required for substation protection, control and monitoring. For example the learning from this project has been used to inform discussion between SSEPD and NGETSO on the future ANM interface at GSPs. Workshops were held as part of the project to consider the transition towards a business as usual roll-out for the Digital Substation project. Outputs included agreement on drafting of a proposal for the NIA project, which the outcomes from the digital substation project has fed into. **References:** ▪ Digital Substation Platform; Closedown report; April 2015. ▪ Questionnaire response
Generates knowledge that can be shared amongst all DNOs	4	**Assessment:** *Specific replication report(s) / information exist.* *There is no evidence of a learning dissemination event or webinar.* **Evidence:** Table 6 and 7 in the closedown report outline components and knowledge required for project replication. Further detail is available on request from SHEPD through futurenetworks@sse.com. There is no evidence of a learning or dissemination event. **References:** ▪ Digital Substation Platform; Closedown report; April 2015.

Focuses on network methods that are at the trialling stage	**2**	**Assessment:** *Solution moved to TRL6 (technology demonstrated in relevant environment* **Evidence:** Section 5.5 of the closedown report shows that the project started at TRL5 and finished at TRL6: “The start TRL of 5 is due to both of the component parts being readily available for procurement in the commercial world, and installed in several locations in the UK, but not having been used together prior to this project, so the subsystems can be regarded as validated technologies. The project has moved the technology of the combined on to a demonstration of the prototype combined system in a relevant test environment. Due to the constraints placed on the testing by the test environment at the PNDC, the next phase of the project would still start at TRL 6.” **References:** ▪ Digital Substation Platform; Closedown report; April 2015.

ANNEX F – DEFINITION OF INNOVATION LEVELS

F.1 Low innovation

Little or no interest in innovation with few innovation projects and no overall programme examining opportunities. There is very limited implementation of new ideas into ‘business as usual’. Resources devoted to innovation are small and organisations are very reluctant to identify and commit further resources. Links with academia, external (potentially disruptive) service providers, and international bodies and organisations – for comparison purposes – are limited and even where they exist they are not strongly pursued.

Innovation is regarded as something undertaken by manufacturers and other suppliers (such as IT companies) and network companies are passive subsequent purchasers. The benefits of an active innovation programme are not perceived or recognised by senior management. Cost, business processes, technical standards and service levels are static or improving at a very low rate.

F.2 Medium innovation

Some interest in innovation but a relatively small number of innovation projects and no overall programme examining opportunities. Implementation of new ideas into ‘business as usual’ is very slow and a risk adverse approach is adopted. People devoted to innovation are comparatively few in number and tend to also have other responsibilities, or to be individuals with a special interest in the development of new approaches. Organisations are reluctant to identify and commit further resources. There are some links with academia, external potentially disruptive service providers, and internationally for comparison purposes but progress and the implementation of real change is slow. Innovation is still regarded as something primarily undertaken by others (such as manufacturers and IT companies) with network companies only really becoming involved at the final trialling and pilot implementation stages. Changes are ‘pushed’ through by others (including the regulator) rather than ‘pulled’ by network companies. The benefits of an active innovation programme are only recognised and seen as a priority to a limited extent by senior management. Cost, business processes, technical standards and service levels are only slowly changing.

F.3 High innovation

Innovation is recognised as a vital ingredient of the business whose success is dependent upon it. Senior management plays a major role in the innovation programme and that role is fully visible both within and outside the company. A comprehensive innovation programme and suite of projects has been developed and is actively managed. The resources to undertake such a programme are provided and reinforced when necessary. There are clear processes for identifying new opportunities and for incorporating maturing developments into “business as usual”. The resources required for this are understood together with the necessary commitment needed from senior management.

Risks are identified and managed rather than avoided. The level of resource allocated to the whole ‘end-to-end’ process is adequate. It is accepted that it is in the nature of innovation that some projects will fail and this is acceptable as long as the project has been adequately managed. Staff who specialise in innovation have a route by which they can progress to senior management posts. Links with academia, external potentially disruptive service providers, and internationally for comparison purposes are vigorously pursued and are seen as a vital contributor to the development of the organisation.

Partnerships with such stakeholders as well as manufacturers, IT companies and other are regarded as essential. There is a continuing programme of implementation with a ‘pipeline’ of further changes being developed. Change is both ‘pushed’ through by external stakeholders (such as those previously mentioned and the regulator) as well as ‘pulled’ through by network companies. The benefits of an active innovation programme are fully recognised and seen as a priority by senior management who take action to ensure that such benefits are achieved. The implementation of the results of the innovation programme led to lower costs, improved business processes, technical standards that recognise changing requirements and improving service levels (such as quality of supply, speedier and cheaper connections, more responsive customer service etc.).

ANNEX G – QUESTIONNAIRES

G.1 Distribution Network Operators

Dear [Insert name],

Pöyry Management Consulting and Ricardo Energy & Environment have been engaged by Ofgem to evaluate the Low Carbon Network Fund (LCNF). A key part of this work is to engage with those who have been involved in the LCNF, and also with those who may have thoughts and views which may help us in this evaluation process. This questionnaire forms an important part of this engagement process. We would therefore be grateful if you are able to take the time needed to complete this questionnaire.

The deadline for your response is.
Please return your questionnaire to LCNFevaluation.ecuk@poyry.com.

This evaluation is separate to the project recently undertaken by EA Technology to assess the 'Summary of LCNF Learning'. The focus of this latest project is an *evaluation* of the fund – including an independent assessment of the extent to which the aims of the fund have been met. This evaluation project also provides an opportunity for DNOs to share thoughts and ideas that could be applied to the governance structure of future innovation schemes.

We are aware that EATL has already questioned members of your organisation on the learning outcomes of the LCNF. We are also aware of the recent Ofgem consultation on the benefits of the LCNF and the governance of the Network Innovation Competition and the Network Innovation Allowance. We have reviewed these consultation responses as part of preparing this latest set of evaluation questions.

Questionnaires are also being sent to other industry stakeholders, for example: LCNF project partners, manufacturers, universities, consultants etc.

We would appreciate your response to the attached questionnaire. The evaluation report will be published by Ofgem in due course.

If you have any questions regarding this questionnaire, or how your views will be used within the consultation process, please feel free to contact us via the details below.

Pöyry Management Consulting	Peter Williams	peter.williams@poyry.com
Ricardo AEA	Sarah Carter	sarah.carter@ricardo.com

Thank you once again for your time in completing this questionnaire.

Kind regards

Peter Williams
Senior Principal

Pöyry Management Consulting
King Charles House; Park End Street
Oxford, OX1 1JD

Benefits of the LCNF projects

1	**For each of your Tier 1 and Tier 2 projects (and any other projects undertaken by other DNOs which you have implemented) please answer the following questions.** **When answering the questions it is important that your assessment should focus on the benefits resulting from the LCNF. These are the benefits over and above what you would have expected had the LCNF has not been implemented. Therefore, the benefits should be presented against your expected view of what would have happened in the absence of the LCNF.** **For each of the questions below, please explain the methodology you have used in assessing the extent of the roll-out and level of benefits, and also please provide the relevant supporting information.** **All answers should be given on a quantitative basis**
1.1	**Move to 'business as usual'** These questions focus on the extent to which the project deliverables have been, or are planned to be, included in 'business as usual' plans.
1.1.1	Indicate the extent to which the deliverables from each of the LCNF projects **<u>are currently included</u>** in your 'business as usual' activities? Notes for answering: ▪ answers should focus on both the learnings from your own projects and also the implementation of learning from projects led by other DNOs. ▪ examples of this could include the number of relevant items installed on the network, changes to business and technical processes and standards or other measures as appropriate.
1.1.2	Describe the plans for **<u>future roll out</u>** of the deliverables for each project to 'business as usual' over next 15 years (i.e. 2031; this aligns with the end of the RIIO-ED2 regulatory period)? Notes for answering: ▪ if appropriate, please provide alternative 'roll-out' scenarios according to, for example, the level of penetration of renewable generation, purchase of electric vehicles or other factors.
1.1.3	Please comment on any deployment obstacles that are either delaying or stopping wide scale adoption of the learning of each of the LCNF projects?

1.3 FINANCIAL BENEFITS

1.2	**CURRENT benefits** in excess of what would have happened if LCNF had not been implemented (refer to 1. Introduction)	Project Name	What would have happened in the absence of the project? (Both monetary, quality of supply or other)	Benefits	Methodology used

All of the questions in this section focus on the benefits that have been achieved up until 31st March 2016 from the individual project or initiative.

For each of the following questions, please provide an answer for each of your projects separately

1.2.1 What is your current estimate of the level of cost saving benefits achieved (annually and cumulatively) from each individual project or initiative

Whilst this information may be in your business plan and or closedown reports we would appreciate your estimate of the latest positon.

1.2.2 Please estimate the level of carbon savings (annually and cumulatively) from the individual project or initiative?

1.2.3 Please estimate the level of new connections facilitated (number and capacity) from the individual project or initiative? Please state whether these are renewable generation, other generation or demand, and where these connections have improved in the quality of supply / capital investment deferred etc.

FUTURE benefits in excess of what would have happened if LCNF had not been implemented (refer to 1. Introduction)	Project Name	What would have happened in the absence of the project? (Both monetary, quality of supply or other)	Project Benefits	Methodology used

The questions in this section focus on the benefits that are expected to result over the next 15 years as direct result of the implementation of a specific LCNF project or initiative that has already been undertaken (i.e.as at 31 March 2016). The 15 years period corresponds with the end of the RIIO-ED2 regulatory period in 2031.

For each of the following questions, please provide an answer for each of your projects separately

1.2.4 What is your estimate of the level of cost saving benefits which will be achieved (annually and cumulatively) from individual projects or initiatives?

1.2.5 Please provide an estimate of the level of carbon savings (annually and cumulatively) that you expect will be achieved as a direct result of each individual project or initiative?

1.2.6 Estimate the level new connections facilitated ((number and capacity) from the individual project or initiative? Please state whether these are renewable generation, other generation or demand), and where these connections have improved in the quality of supply / capital investment deferred etc.

1.3	**WORKING WITH OTHERS**
1.3.1	Please outline the stakeholder engagement mechanisms you have used to develop LCNF projects?
1.3.2	Please outline the processes you have used to develop the LCNF project ideas?
1.3.3	Please provide details (to the extent possible) of companies and contacts who may have approached you with ideas for LCNF projects, but with whom you did not work? If possible can you explain why you chose not to go ahead with their ideas?
1.3.4	Please outline the processes you used to share learning from the LCNF trials.
1.3.5	How has the involvement of third parties affected the breadth of innovation or success of the projects?
1.3.6	Are you aware of any barriers that may have discouraged project partner involvement?
1.4	**Additional benefits and other indirect impacts**
1.4.1	Please provide details of any indirect benefits/dis-benefits, or other impacts associated with LCNF as a whole? Notes for answering: This might include synergies or conflicts arising from the interaction between individual projects or initiatives as well as organisational or company benefits or cultural change associated with participation in the LCNF scheme as a whole (i.e. not easily attributable to specific projects).

Innovation in GB and Internationally

2.1	To what extent do you believe that these innovation projects would have occurred without the LCNF? Are you able to provide examples to support your view?
2.2	Do you believe the LCNF has prevented, or otherwise discouraged, private sector innovation? Are you able to provide examples to support your view?
2.3	What methods of innovation funding are you aware of internationally? How successful have overseas DNOs been in innovating, please provide examples
2.4	What gaps or problems do you perceive in the present research funding arrangements in GB and Europe? Do these present a barrier to successful

Additional comments

3.1	Please make any additional comments in respect of the LCNF success or otherwise here.

G.2 Project Partners

Dear [Insert Name],

Pöyry Management Consulting and Ricardo Energy & Environment have been engaged by Ofgem to evaluate the Low Carbon Network Fund (LCNF). A key part of this work is to engage with those who have been involved in the LCNF, and also with those who may have thoughts and views which may help us in this evaluation process. This questionnaire forms an important part of this engagement process. We would therefore be grateful if you are able to take the time needed to complete this questionnaire.

The deadline for your response is.

Please return your questionnaire to LCNFevaluation.ecuk@poyry.com.

We believe that your direct involvement in LCNF projects provides a strong basis for you to make a valuable contribution to this evaluation being undertaken by Ofgem.

We are aware of the recent Ofgem consultation on the benefits of the LCNF and the governance of the Network Innovation Competition and the Network Innovation Allowance. We have reviewed these consultation responses as part of preparing this latest set of evaluation questions.

We would appreciate your response to the attached questionnaire. The evaluation report will be published by Ofgem in due course. Please note that your answers will be used anonymously.

If you have any questions regarding this questionnaire, or how your views will be used within the consultation process, please feel free to contact us via the details below.

Pöyry Management Consulting	Peter Williams	peter.williams@poyry.com
Ricardo AEA	Sarah Carter	sarah.carter@ricardo.com

Thank you once again for your time in completing this questionnaire.

Kind regards

Peter Williams
Senior Principal

Pöyry Management Consulting
King Charles House
Park End Street
Oxford, OX1 1JD

Success of the Low Carbon Network Fund

1	Objectives of the LCNF can be summarised as: ▪ Incentivising the DNOs to include innovation as part of their core business. ▪ Helping the DNOs to move towards a low carbon business whilst maintaining security of supply and delivering value for money to customers. ▪ Helping the DNOs facilitate low carbon and energy saving initiatives. ▪ Dissemination of learning to facilitate roll out of successful trials and subsequent network savings and or carbon benefits. ▪ Collaboration between the DNOs, and with third party project partners.
1.1	Do you believe that the LCNF has met its objective in incentivising the DNOs to include innovation as part of their core business? What justification do you have for your response?
1.2	Do you believe that the LCNF has met its objective of helping the DNOs move towards a low carbon business whilst maintaining security of supply and delivering value for money to customers? What justification do you have for your response?
1.3	Do you believe that the LCNF has met its objective of helping the DNOs facilitate low carbon and energy saving initiatives? What justification do you have for your response?
1.4	Do you believe that the LCNF has met its objective of the dissemination of learning to facilitate roll-out of successful trials? Are you able to provide examples to support your view? Are you aware of learning being implemented from trials by other DNOs as well as their own? Are you able to provide examples to support your views?
1.5	Do you believe that the LCNF has met its objective of effective collaboration between the DNOs and project partners? Where appropriate please provide evidence of the success, or otherwise, of collaboration.
1.6	Are you aware of any barriers that may have affected the outcome of the projects?
1.7	Are you aware of any barriers that may have discouraged project partner involvement?
1.8	In your view, which parts of the LCNF have worked well and which haven't? What would you change in retrospect and why?

Innovation in GB

2.1	To what extent do you believe that these innovation projects would have occurred without the LCNF? Are you able to provide examples to support your views?
2.2	Do you believe the LCNF has prevented, or otherwise discouraged, private sector innovation? Are you able to provide examples to support your view?
2.3	Do you think third party access to LCNF funding would improve the quality of innovation projects and if so why?

LCNF Scheme Overview

3.1 How well did Ofgem communicate information regarding the introduction of the LCNF effectively? Were you aware of the LCNF from the outset?

Was there sufficient information to enable you to understand how you could get involved with the scheme?

3.2 Do you believe the initial LCNF criteria set out by Ofgem was appropriate? Did the criteria give you a clear understanding of the types of projects Ofgem was expecting?

3.3 Did Ofgem communicate information regarding the LCNF effectively? (e.g. changes to the scheme etc.)

3.4 Was the application process straightforward to understand and follow? Was it made clear to you what should be included within your application?

3.5 Was the process for 'project selection' clear? Was this clearly communicated?

3.6 Did Ofgem follow the 'project selection' criteria as has been outlined? Was there sufficient communication between Ofgem and yourself during the selection process (e.g. did Ofgem ask any clarification questions)?

3.7 In cases where a project was rejected, how would you rate the quality of the feedback provided by Ofgem on the reason for its decision?

3.8 How has the LCNF altered your perception of how innovation is viewed by Ofgem?

Specific Project Partner Questions

4.1 How did you become involved in an LCNF project? Were the DNOs proactive or reactive in their engagement with you?

4.2 How did you contribute to the initial project innovation ideas and scoping?

4.3 How did you contribute to the success of the project, how were ideas developed and incorporated during the project?

4.4 How did you contribute to the project roll out?

4.5 What general comments do you have about the engagement mechanisms used by the DNOs in respect of initiation, your inclusion and involvement and development of ideas throughout the project lifespan?

4.6 How well did the LCNF allow satisfactory commercial arrangements?

4.7 To what extent are Intellectual Property (IP) rights treated appropriately within the LCNF and have any concerns been addressed in the latest NIC IP arrangements?

Additional comments

5.1 Please make any additional comments in respect of the LCNF success or otherwise here.

The next section is intended for research establishments:

Research Establishment Questions

6.1 Has the LCNF increased your engagement with DNOs? Please provide examples where you can.

6.2 Do you think the LCNF fits appropriately into the existing GB research framework? (e.g. how appropriate is it from a Technology Readiness Level perspective?; how do LCNF projects build on 'Innovation Funding Initiative' (and 'Network innovation Allowance') projects, The Engineering and Physical Sciences Research Council funded research and development funded by other organisations such as Innovate UK, Catapult and ETI etc.)

6.3 What is your opinion of how the NIA (previously IFI) and the NIC (previously LCNF) fits with the Horizon 2020 European research programmes?

6.4 Aside from the above are there any other gaps or problems that you perceive in the present research funding arrangements in GB and Europe which are a barrier to successful innovation?

6.5 Are you aware of any international innovation funding mechanisms that should be considered in our evaluation?

G.3 Industry Members

Dear [Insert name],

Pöyry Management Consulting and Ricardo Energy & Environment have been engaged by Ofgem to evaluate the Low Carbon Network Fund (LCNF). A key part of this work is to engage with those who have been involved in the LCNF, and also with those who may have thoughts and views which may help us in this evaluation process. This questionnaire forms an important part of this engagement process. We would therefore be grateful if you are able to take the time needed to complete this questionnaire.

The deadline for your response is.

Please return your questionnaire to LCNFevaluation.ecuk@poyry.com.

We believe that your knowledge of working within the industry provides a strong basis for you to make a valuable contribution to the evaluation Ofgem is undertaking.

We would appreciate your response to the attached questionnaire. The evaluation report will be published by Ofgem in due course. Please note that your answers will be used anonymously.

We are aware of the recent Ofgem consultation on the benefits of the LCNF and the governance of the Network Innovation Competition and the Network Innovation Allowance.

Please also consider passing this questionnaire to a colleague who you think may have an interest in responding. This will help us to ensure as broad and varied a spread of views as possible. If you decide to do so, please provide us with their contact details so that we can track and ensure all responses are received in time.

If you have any questions regarding this questionnaire, or how your views will be used within the consultation process, please feel free to contact us via the details below.

Pöyry Management Consulting	Peter Williams	peter.williams@poyry.com
Ricardo AEA	Sarah Carter	sarah.carter@ricardo.com

Thank you once again for your time in completing this questionnaire.

Kind regards

Peter Williams
Senior Principal

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Oxford, OX1 1JD

Success of the Low Carbon Network Fund (LCNF)

1	Objectives of the LCNF can be summarised as: ▪ Incentivising the DNOs to include innovation as part of their core business ▪ Helping the DNOs to move towards a low carbon business whilst maintaining security of supply and delivering value for money to customers. ▪ Helping the DNOs facilitate low carbon and energy saving initiatives ▪ Dissemination of learning to facilitate roll out of successful trials and subsequent network savings and or carbon benefits ▪ Collaboration between the DNOs, and with third party project partners
1.1	Do you believe that the LCNF has met its objective in incentivising the DNOs to include innovation as part of their core business? What justification do you have for your response?
1.2	Do you believe that the LCNF has met its objective of helping the DNOs move towards a low carbon business whilst maintaining security of supply and delivering value for money to customers? What justification do you have for your response?
1.3	Do you believe that the LCNF has met its objective of helping the DNOs facilitate low carbon and energy saving initiatives? What justification do you have for your response?
1.4	Do you believe that the LCNF has met its objective of the dissemination of learning to facilitate roll-out of successful trials? Are you able to provide examples to support your view? Are you aware of learning being implemented from trials by other DNOs as well as their own? Are you able to provide examples to support your views?
1.5	Do you believe that the LCNF has met its objective of effective collaboration between the DNOs and project partners? Where appropriate please provide evidence of the success, or otherwise, of collaboration.
1.6	Are you aware of any barriers that may have affected the outcome of the projects?
1.7	Are you aware of any barriers that may have discouraged project partner involvement?
1.8	In your view, which parts of the LCNF have worked well and which haven't? What would you change in retrospect and why?

Innovation in GB

2.1	To what extent do you believe that the innovation projects would have occurred without the LCNF? Are you able to provide examples to support your views?
2.2	Do you believe the LCNF has prevented, or otherwise discouraged, private sector innovation? Are you able to provide examples to support your view?
2.3	Do you think third party access to LCNF funding would improve the quality of innovation projects and if so why?

Additional Comments

3.1 Please make any additional comments in respect of the LCNF success or otherwise here.

The next section is intended for research establishments:

Research Establishment Questions

4.1 Has the LCNF increased your engagement with DNOs? Please provide examples where you can.

4.2 Do you think the LCNF fits appropriately into the existing GB research framework? (e.g. how appropriate is it from a Technology Readiness Level perspective?; how do LCNF projects build on 'Innovation Funding Initiative' (and 'Network innovation Allowance') projects, The Engineering and Physical Sciences Research Council funded research and development funded by other organisations such as Innovate UK, Catapult and ETI etc.)

4.3 What is your opinion of how the NIA (previously IFI) and the NIC (previously LCNF) fits with the Horizon 2020 European research programmes?

4.4 Aside from the above are there any other gaps or problems that you perceive in the present research funding arrangements in GB and Europe which are a barrier to successful innovation?

4.5 Are you aware of any international innovation funding mechanisms that should be considered in our evaluation?

G.4 Academics

Innovation in GB	
1. Assessing the effectiveness of the Low Carbon Network (LCNF) innovation stimulus on the distribution network operators (DNO's) in the GB distribution sector requires a definition of what is meant by 'innovation', as well as an understanding of the (innovation) performance of the sector at the time that the LCNF was introduced. *We would welcome your view on the questions set out below. These address the nature of innovation, the criteria for assessing such innovation (this may be a mixture of quantitative and qualitative aspects) and the position regarding innovation in the sector at the time that the LCNF was introduced.*	
- Please can you describe your understanding of what is meant by 'innovation' and, if possible, provide a definition in the context of the LCNF?	
- What criteria should be used to assess the level of innovation of an individual DNO or the GB distribution sector as a whole?	
- Based on this criteria, how would you characterise the level of innovation in the GB distribution sector as a whole at the time of the introduction of the LCNF mechanism?	
- At the time of the introduction of LCNF do you think that the level of demonstrated innovation differed between DNOs – if so, what were the key differences?	
2. Another important aspect of assessing the effectiveness of the LCNF is to estimate the benefits that have resulted from the scheme and to compare these with what otherwise may have been expected in the absence of the LCNF innovation stimulus. In order to do this we have developed a number of counterfactual scenarios against which to compare the *actual* outcome for the purpose of estimating the benefits that (i) the LCNF has provided; and (ii) will provide in future. There are three such counterfactual scenarios. In the first scenario, it is assumed that DNOs have demonstrated a *low* level of innovation. In the second scenario a *medium* level of innovation and in the third scenario a *high* level of innovation is assumed. A description of what behaviours DNOs would exhibit in each of these three scenarios is provided in Appendix 1 to this paper. The aim is to compare the benefits that the LCNF has provided with what might have otherwise occurred if DNOs had performed and behaved in line with each of the scenarios. *We are interested in your opinion as to whether this scenario-based approach to determining a counterfactual position is a reasonable, or effective, method of evaluating the LCNF. We are also keen to hear your views on alternative approaches that could be used, the appropriateness of the scenarios that have been described (please see Appendix 1), and how to make meaningful comparisons between actual*	

performance and that suggested by each of the three scenarios. These points are examined in the following questions.	
- Is the use of *low*, *medium* and *high* innovation scenarios a useful way of assessing the effectiveness of the LCNF? If not, why not, and what other approaches would you suggest?	
- Do the descriptions in Appendix 1 appropriately describe *low*, *medium* and *high* innovation scenarios? Do you have any suggestions as to how these could be improved?	
- Based on the criteria mentioned in Question 1, how would you characterise the level of innovation in the distribution sector (as a whole) since the introduction of the LCNF? Are different levels of innovation being demonstrated by different DNOs – if so, what are the differences?	
- Based on the descriptions of *low*, *medium* and *high* innovation scenarios described in Appendix 1, where do you think that the distribution network sector as a whole <u>was placed at the time of the introduction of the LCNF?</u> What reasons would you give for this? Did this vary between DNOs? If so, what were the key differences?	
- Based on the descriptions of *low*, *medium* and *high* innovation scenarios described in Appendix 1 where do you think that the distribution network sector as a whole <u>is now placed (i.e. since the introduction of the LCNF</u>)? What reasons would you give for this? Does this differ for different DNOs? If so, what are the key differences?	
- What proportion (approximately) of the benefits attributed to the LCNF would it be reasonable to assume might have occurred anyway under each of the three counterfactual scenarios: - *Low* innovation? - *Medium* innovation? - *High* innovation? *[as an example, your view might be*	

that under a high innovation scenario (where DNOs are strongly committed to innovation), a relatively high proportion of the benefits attributed to the LCNF would have happened anyway; whereas under a low innovation scenario (where DNOs are demonstrating much less innovation activity), a much lower proportion would have occurred]

- Is the above scenario approach an effective way to evaluate the benefits of the LCNF scheme? How would you capture these benefits and determine what has occurred? Please describe any alternative approaches that you may be aware of that you feel could be more effective.

3. It would also be useful to have your views about the LCNF more generally.
Please respond to the questions below

Please describe the ways in which you think that the LCNF has (i) been successful and the benefits that it has brought; and (ii) not been as successful at it might have been and why

Please provide any suggestions on how the LCNF (now the Network Innovation Allowance and Network Innovation Competition) could be improved

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