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LCN Fund Low Carbon Networks

# Low Carbon Networks Fund: 2014 funding decision

## Decision on the fifth year competition

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**Overview**

We run an annual Low Carbon Networks (LCN) Fund competition to stimulate innovation in electricity distribution networks. Through the LCN Fund, electricity distribution network operators (DNOs) can apply in partnership with others for up to £64 million to fund innovative low carbon projects which benefit electricity consumers. This document explains which projects we have selected for funding this year.

This was the fifth and final year of the LCN Fund – next year the competition will run in a different form.

There were four applications and we have selected all four projects for funding. This decision is consistent with the recommendations of our independent expert panel. We propose to award £21.9 million of the available £64 million to these projects. The DNOs and a range of partners will invest £3.1 million of additional funding and in kind contributions in the projects.

The successful projects trial innovative practices and new technologies. They were selected because they will help DNOs understand how to meet customers' changing requirements as different forms of generation connect and customers' use of the network changes.

# Context

Electricity distribution networks are entering a period of significant change. The challenges presented by new technology and the transition to a low carbon economy will directly affect distribution networks and the way their operators interact with customers.

As part of the last electricity distribution price control (DPCR5), we established the £500 million LCN Fund. The aim of this fund is to stimulate innovation and to give DNOs the opportunity to obtain funding to trial innovative solutions to the challenges in running their networks in the future. These trials are needed so that DNOs can understand the changing needs of consumers, generators and other stakeholders, particularly as we move towards a low carbon economy. Ultimately, they could result in lower costs for all customers.

The learning gained from these trials will be disseminated to all DNOs and will be widely available to other interested parties to help them make the changes required in a timely and cost-effective way. Learning from the trials will feed into the policy work of the Smart Grid Forum, which is jointly chaired by us and the Department of Energy and Climate Change.

# Associated documents

LCN Fund Governance Document v.6

DPCR5 Final Proposals - Incentives and Obligations (145/09)

# Contents

# Executive summary

We received four submissions to the final LCN Fund competition. The projects requested total funding of £21.9 million from the available £64 million.[1] We have selected all four projects for funding, in line with the recommendations of our independent expert panel.

The table below summarises the four projects submitted.

| Project | Funding requested |
|---|---|
| **Fault Level Active Response**<br>This project will demonstrate new techniques for mitigating the effects of increasing fault currents. These techniques could help avoid fault level reinforcement costs and facilitate lower cost connections to the network.<br>*Submitted by Electricity North West Limited (in partnership with ABB, PB Power, ENER-G, United Utilities, Schneider Electric, Impact Research and the CHPA)* | £4.43m |
| **Kent Area System Management**<br>This project will trial new software for managing power flows on a 132kV network with a lot of intermittent generation. The software could help DNOs to operate the network closer to its operational limits, releasing additional capacity and delaying the need for reinforcement.<br>*Submitted by UK Power Networks (in partnership with National Grid and Navigant Consulting)* | £3.34m |
| **Low Energy Automated Networks**<br>This project will investigate, demonstrate and evaluate a new operational technique that could reduce fixed electrical losses from transformers.<br>*Submitted by SSE Power Distribution (partners/ suppliers to be selected)* | £2.67m |
| **Network Equilibrium**<br>This project will test new methods for optimising voltages and managing power flows over wide areas of the distribution network. The methods could help DNOs use existing network capacity to connect new demand and generation customers quicker and cheaper.<br>*Submitted by Western Power Distribution (partners/ suppliers to be selected)* | £11.48m |

We assessed the project proposals against published criteria in the LCN Fund Governance Document, which are summarised in Appendix 1.[2]

This was the fifth and final year of the LCN Fund competition. We will continue to monitor existing LCN Fund projects (including those funded this year). From next year, the DNOs will be eligible to compete for funding under the Electricity Network Innovation Competition (NIC).

[1] The terms "the Authority", "Ofgem", "we" and "us" are used interchangeably in this document. The Authority is the Gas and Electricity Markets Authority. Ofgem is the office of the Authority.
[2] The LCN Fund Governance Document and the evaluation criteria have been formulated against our principle objectives and general statutory duties.

# 1. Introduction

**Chapter summary**

This chapter describes the background and structure of the LCN Fund, how we and the expert panel have evaluated projects, and the process we followed during this year's second tier competition.

## Purpose

1.1. This document explains our decisions on the applications made to the fifth LCN Fund competition. We assessed the projects against the evaluation criteria in the LCN Fund Governance Document.[3] The criteria are summarised in Appendix 1.

1.2. We have published a number of other documents alongside this decision. These are -

- The full submissions and the resubmissions for the projects. These provide the information we used to evaluate them.
- The independent expert panel's recommendations on which projects should receive funding.
- Reports by our consultant, Frazer Nash, on each project (based on the original project submission). These include a set of challenges posed to the DNOs by the consultant, the DNOs' responses to the challenges and the consultant's conclusions. The reports aided the expert panel's and our assessment.
- The DNOs' answers to questions that we, Frazer Nash and the expert panel raised on each project.

1.3. This document constitutes both notice of and reasons for our decision as required under section 49A of the Electricity Act (1989).

## The LCN Fund

1.4. Network companies, including DNOs, need to consider how they can play a full role in tackling the challenges posed by the changes in the energy system while maintaining security of supply and providing customers with value for money. Significant investment in Great Britain's gas and electricity network infrastructure is needed to help achieve this.

[3] You can find the LCN Fund Governance Document (v6) here.

1.5. To encourage DNOs to innovate to meet these challenges, we created the £500 million LCN Fund as part of the fifth Electricity Distribution Price Control Review (DPCR5). It is designed to enable DNOs to trial new technologies, operating practices and commercial arrangements which are required to meet the challenges associated with the transition to a low carbon economy. The evaluation criteria encourage DNOs to engage with third party technology providers and other stakeholders when developing projects.

1.6. The LCN Fund was established to help the DNOs explore how their role in the energy sector might be different in the future. The LCN Fund projects will also help the DNOs understand what role they can play in enabling the transition to a smarter, low carbon energy sector. As such, the learning from the selected projects is important not just for DNOs but for the energy industry and its stakeholders as a whole. A key feature of the LCN Fund is the requirement that learning gained from projects must be widely disseminated, so customers across Great Britain gain significant return on their funding through the roll-out of successful projects and the subsequent network cost savings and/or carbon benefits.

## Structure of the LCN Fund

1.7. The LCN Fund encourages DNOs to innovate in the way they design, develop and operate their networks. It consists of two funding tiers and a discretionary funding mechanism. The first tier funds DNOs for small-scale projects and provides funding to put in place the people, resources and processes to progress innovative projects. The first tier provides up to £80 million in funding over the five years to 2015. To date, projects worth £24.1 million have been registered through the first tier.

1.8. Under the second tier, we hold an annual competition which funds a small number of large-scale innovation projects. DNOs compete against each other for an allocation of up to £64 million of available funding each year. This document explains our decision on the projects we have selected for second tier funding in this fifth and final year of the competition.

1.9. Finally, £100 million of the fund is available to provide discretionary rewards to projects (first and second Tier) that bring particular value to the challenge of preparing networks for the meeting customers' changing needs. Its purpose is to provide a strong incentive for DNOs to develop well-designed and successful projects. We have consulted on how we will administer this funding and the arrangements will be in place by 1 April 2015.

## Second tier process

1.10. The LCN Fund Governance Document explains how the LCN Fund is governed and administered.

1.11. The annual competition starts with DNOs submitting outline project proposals in the initial screening process (ISP). During ISP, we consider whether these proposals are eligible for funding. Only eligible projects are allowed to progress to the full submission stage.

1.12. Successful DNOs are invited to develop the eligible projects into full submissions. Although we decide which projects are funded, we are advised by an independent panel of experts.[4] The expert panel members are recruited for their knowledge and expertise covering energy networks, environmental policy, technical and engineering issues, economics and finance, and consumer affairs. The panel assesses each project against the evaluation criteria.

## The 2014 competition

1.13. This year's competition began with the ISP in April 2014. We received four submissions and were satisfied that they all met the ISP eligibility requirements. This meant DNOs could develop their ideas into full submissions. We received all four submissions by the deadline of 25 July 2014. A brief summary of each project is in chapter 2 and all the ISP and full submissions are on our website.

1.14. This year the fund was undersubscribed. The total funding requested was £21.9 million (excluding bid preparation costs) from the available £64 million.

1.15. The expert panel conducted a thorough evaluation of the submissions. It reviewed the DNOs' submissions and Frazer Nash's reports. It also met the DNOs and their project partners twice. It then evaluated the projects against the criteria in the LCN Fund Governance Document. Where aspects of their submissions required clarification, the DNOs had the opportunity to make the necessary changes and resubmit their proposals. The panel made its recommendations based on the final submissions. It submitted its recommendations report to us in early November 2014.

1.16. Frazer Nash scrutinised the original project submission, validating the information supplied and challenging the risks and potential shortfalls of the projects in its reports. The DNOs were sent a draft of the consultant's report and responded to the challenges that were made in writing. Frazer Nash then updated its reports to include the DNOs' responses and provided its final analysis.[5] In addition, we, Frazer Nash and the expert panel asked questions of the companies throughout the process. All of the questions and answers have been published on our website along with Frazer Nash's reports.[6]

1.17. We assessed the projects, taking into account the expert panel's recommendations and the evaluation criteria, to decide which projects should receive funding. This assessment is included in Appendix 1.

[4] Details about the expert panel members can be found here.
[5] This was based on the first submission; the consultant was not required to review the resubmission.
[6] You can find all the documents here. This includes the expert panel's report, the full submissions, the consultant's reports and the questions and answers.

# 2. Decision

**Chapter summary**

We have decided to fund all four of the projects submitted. In total, we are approving £21.9 million of funding. This chapter explains the reasons for our decision.

## Overview of full submissions

2.1. We were pleased by the standard of this year's submissions and note that they will seek to address a number of important issues. Some of the projects could enable DNOs to monitor and manage their networks more dynamically – moving them further along the road to becoming distribution system operators.

2.2. On the whole, the proposals were well researched, clearly explained and properly evidenced. However, one of the projects would have benefited from additional work before full submission to address potential risks. Another could have done more to set out the project's objectives more clearly.

2.3. The expert panel noted that the DNOs should look to draw on feasibility studies, previous innovation projects and existing experience elsewhere when developing their submissions. We encourage the DNOs to work closely with their stakeholders to explore a wide range of issues and approaches. This will help them further expand the scope and ambition of their innovation, while also ensuring that submissions to future competitions are well developed with clear methodologies.

2.4. Last year, we were concerned that it was not always clear that competitive selection processes had been undertaken where practicable. This year, we were pleased to see that all projects included competitive selection for technical support and equipment suppliers. In one case, there was clear evidence that this had reduced the cost of the project – adding to the value for money for customers. Where selection is yet to be undertaken, the submissions include clear commitments to do so competitively.

2.5. The panel considered that most of this year's submissions were of a high quality – in terms of both presentation and content. The panel noted that the projects will seek to challenge industry orthodoxies and provide valuable learning in the process. It also noted the importance of well conducted trials and learning dissemination in ensuring that the results can be rolled out as normal business and providing the basis for progress towards the low carbon economy. The full detail of the panel's assessment of the projects is in chapter 3 of its recommendations report.

## Our decision

2.6. We have considered the project submissions, the expert panel's recommendations and the consultant's reports against the competition's framework and our statutory and other duties. We have selected all four projects for funding as submitted (listed in Table 2.1).

**Table 2.1: Projects selected for funding as submitted**

| Project | Funding request | DNO |
|---|---|---|
| **Fault Level Active Response**<br>This project will demonstrate new techniques for mitigating the effects of increasing fault currents. These techniques could help avoid fault level reinforcement costs and facilitate lower cost connections to the network.<br>*Submitted by Electricity North West Limited (in partnership with ABB, PB Power, ENER-G, United Utilities, Schneider Electric, Impact Research and the CHPA)* | £4.43m | Electricity North West |
| **Kent Area System Management**<br>This project will trial new software for managing power flows on a 132kV network with a lot of intermittent generation. The software could help DNOs operate the network closer to its operational limits, releasing additional capacity and delaying the need for reinforcement.<br>*Submitted by UK Power Networks (in partnership with National Grid and Navigant Consulting)* | £3.34m | UK Power Networks |
| **Low Energy Automated Networks**<br>This project will investigate, demonstrate and evaluate a new operational technique that could reduce fixed electrical losses from transformers.<br>*Submitted by SSE Power Distribution (partners/ suppliers to be selected)* | £2.67m | SSE Power Distribution |
| **Network Equilibrium**<br>This project will test new methods for optimising voltages and managing power flows over wide areas of the distribution network. The methods could help DNOs use existing network capacity to connect new demand and generation customers quicker and cheaper.<br>*Submitted by Western Power Distribution (partners/ suppliers to be selected)* | £11.48m | Western Power Distribution |

## Reasons for our decision

2.7. We reviewed each submission against the evaluation criteria. These assessments are in Appendix 1 of this document. Below we summarise the reasons for our decision.

2.8. The total funding requested this year was below the £64 million annual funding limit. This made it possible for us to fund all projects, although we only fund projects which perform well against the evaluation criteria. We consider that all four projects this year met the criteria and were of sufficient quality for us to fund them.

## Projects selected for funding

### *Fault Level Active Response - FLARE (Electricity North West Limited)*

*Overview*

2.9. This project aims to address the problem of increasing fault current levels on the distribution network. The project would develop a fault level assessment tool for identifying potential fault current levels in real-time. The project would also aim to demonstrate three techniques for mitigating the effects of fault currents – two technical and one commercial. The fault current assessment tool would help to identify when to use each technique.

*Summary of assessment*

2.10. The techniques that this project aims to demonstrate are innovative and have the potential to be rolled out across GB. The project would help the rollout of low carbon technologies (LCTs) by releasing capacity that is currently constrained by potential fault current levels. The project would also deliver significant financial benefits by releasing capacity and avoiding reinforcement.

2.11. The project could lead to considerable new knowledge, including contract templates for a new type of commercial arrangement – a fault-current-limiting service – and a safety case for deploying $I_s$-limiters on GB distribution networks for the first time.

2.12. The project has a strong methodology, demonstrating good value for money. Electricity North West Limited (ENWL) completed competitive procurement activities between full submission and resubmission. As a result of these activities, ENWL was able to submit a lower cost funding request for the fault current assessment software. ENWL also secured £515,000 of external funding and in-kind contributions from a number of project partners, including ABB, Schneider Electric, Parsons Brinckerhoff, United Utilities, Combined Heat and Power Association, ENER-G and Kelvatek.

2.13. Overall, FLARE performed strongly across all of the evaluation criteria. We plan to fund it as submitted.

### *Kent Area System Management - KASM (UK Power Networks)*

*Overview*

2.14. This project aims to demonstrate Contingency Analysis software that could be used by DNOs' long-term capacity planners, outage planners and (real-time) control room engineers. The software will provide more accurate information about network performance and help DNOs move away from worst case scenario assumptions when

planning and operating their networks. UK Power Networks (UKPN) expects this to enable DNOs to operate their networks closer to their limits, getting more use out of existing assets and lowering costs for customers.

*Summary of assessment*

2.15. This project could support the rollout of LCTs by enabling the cheaper connection of new renewable generators. It could also help avoid constraining existing renewable generators during network outages. The software could be used by all DNOs to defer reinforcement investment and deliver modest financial benefits. This project has the potential to deliver important learning on the DNOs' journey towards becoming distribution system operators. This is because it could let them operate their networks according to actual conditions on the network rather than using conservative engineering assumptions.

2.16. Contingency Analysis has the potential to be rolled out by all DNOs. The software will be available to the other DNOs at an equivalent price to that provided to UKPN and the integration source code (along with the relevant specifications and other key documentation) will be available to the DNOs free of charge. This should enable the other DNOs to integrate Contingency Analysis into their own IT systems – and maximise the benefits of GB-wide rollout.

2.17. UKPN will make an additional financial contribution of £72,000 over and above the compulsory DNO contribution.

2.18. Overall, KASM performed strongly across all of the evaluation criteria. We plan to fund it as submitted.

***Low Energy Automated Networks - LEAN (SSE Power Distribution)***

*Overview*

2.19. This project aims to demonstrate a new operational practice called Transformer Auto Stop Start (TASS). It aims to prove that fixed transformer losses can be reduced by switching off one of a pair of transformers at a substation, without detriment to the transformers or network operation. The transformers will be switched off when they are being underused and back on when load increases.

*Summary of assessment*

2.20. The project could facilitate a low carbon energy sector by reducing the distribution networks' $CO_2$ emissions. By enabling DNOs to reduce network losses the project could deliver modest financial savings directly to customers. Losses are an issue for all DNOs, as well as the wider industry. Under current arrangements, the full cost of electricity losses is borne by customers. The TASS method could be rolled out across all DNO areas to help tackle this significant issue.

2.21. The expert panel was concerned that the potential risks of TASS to transformer health would be a key issue for other DNOs considering the rollout of TASS. In this regard, the panel was worried that the other DNOs had not been engaged during preparation of the submission. While we did not consider these concerns to be irresolvable, we note that engagement with the DNOs and transformer manufacturers in preparing this submission could have addressed some of these concerns and resulted in a stronger submission.

2.22. In its resubmission, SSE Power Distribution (SSEPD) committed to getting written confirmation from the DNOs that TASS is suitable for rollout before moving to the trial stage. This commitment gave the panel comfort that the project could deliver the learning needed to facilitate the rollout of the methods.

2.23. We consider that the other DNOs would need to be involved at an early stage of the trial design phase to ensure that they are comfortable with the methodology and can have confidence in the results of the project's trials. We, therefore, expect SSEPD to engage appropriately with the other DNOs on the trial methodology prior to reaching the decision on whether to continue to the next stage.

2.24. As SSEPD will be taking the risk of a decision to continue to stage two of the project, it will need to satisfy itself that the evidence gathered during the first stage justifies continuing to the second stage. We would expect this to include robust evidence that the proposed decision criteria in the full submission have been met, including –

- an updated benefits case demonstrating a positive NPV for the rollout of TASS,
- evidence (based on discussions with manufacturers) that any risk to transformer health can be mitigated such that it does not outweigh the benefits of the project, and
- written confirmation from the other DNOs that they have been consulted through phase one of the project and consider that the methodology, and project overall, is appropriate to support the future rollout of TASS.

2.25. LEAN generally performed well across the evaluation criteria. We therefore plan to fund the project, but it will need to develop a robust methodology with significant input from the other DNOs before proceeding to stage two.

***Network Equilibrium (Western Power Distribution)***

*Overview*

2.26. This project aims to develop a range of methods for DNOs to control voltages and manage power flows over their 11kV and 33kV networks. These methods include trialling a new modelling tool, new software for dynamically optimising transformer

settings and the use of power electronic devices for coupling separate sections of the network - called flexible power links (FPLs). The project would also explore the case for extending the statutory voltage limits for the 11kV and 33kV networks.

*Summary of assessment*

2.27. If successful, the methods could release significant capacity on the network which would be available for new renewable generation connections and the growth of low carbon demand. The methods could provide this capacity quicker and cheaper than traditional reinforcement, potentially delivering significant financial benefits to distribution customers across Great Britain.

2.28. The panel was concerned about the cost of trialling FPLs on both the 11kV and 33kV networks. It felt that the learning from the application of an FPL to one voltage level would be relevant to the other, so trialling both at the same time would not represent best value for money. The panel's concern was alleviated at resubmission because WPD chose to reduce the scale of the FPL trial to just the 33kV level. While not significantly reducing the scope of the project, this reduced the cost and improved the value for money of the project.

2.29. Nevertheless, we expect the project to capture learning relevant to the application of FPLs at 11kV. In particular, we would have expected the revised learning outputs associated with SDRC 9.6 to address how the learning from the 33kV trial could be applied to future use of FPLs at 11kV. As this expectation was not clearly included in the submission, we will add it to the Successful Delivery Reward Criteria (SDRC) in the project direction.

2.30. While the project methodology appears robust and appropriate, the panel found the purpose and objectives of the enhanced voltage assessment method to be poorly explained in the submission. We encourage DNOs to think carefully about how to make sure that the purpose and objectives of proposed methods are clearly articulated in future submissions.

2.31. Network Equilibrium performed well across all of the evaluation criteria. We plan to fund it, subject to WPD accepting the project direction.

## Customer issues in running the projects

2.32. This year's projects are unlikely to impact on customers during the trials.

2.33. The projects will trial new software, technologies and operational practices directly on the distribution networks. We are satisfied that all of the successful projects have sufficiently considered their effect on customers – such as reduced power quality or increased noise levels – and have committed to appropriate measures to minimise any potential impact.

2.34. None of the projects will involve engagement with domestic customers and only one project, FLARE, will involve non-domestic customers. The FLARE project will involve recruiting up to five industrial and commercial customers to test a new commercial arrangement. This will involve the DNO installing and controlling equipment on the customers' sites. Customers will enter the arrangements voluntarily. The DNO plans to approach potential participants through relevant industry groups, who are partners in the project.

# 3. Next steps

**Chapter summary**

We will issue project and funding directions in December 2014. If these are accepted, the relevant DNOs will start receiving funds from 1 April 2015. We will publish the date for next year's competitions early in 2015.

## Funding selected projects

3.1. Before funding a project, we will issue a project direction explaining the terms that the funding DNO must meet as a condition of the funding.[7] We are currently preparing project directions for the successful projects and we will issue draft versions of these to funding DNOs shortly.

3.2. Once the DNO has accepted the project direction, we will issue a separate funding direction. This will set the amount of money each DNO will be allowed to recover from its customers over the next regulatory year. The funding direction will also require all DNOs to raise funds to be transferred to the relevant DNOs to fund the selected projects.[8] We will issue the funding direction in time for the DNOs to prepare their indicative use of system tariffs at the end of December 2014. The funding direction will take account of any funding to be returned to customers, including revenue from royalties generated by LCN Fund projects.

3.3. Although funding will not be raised from customers until the next regulatory year (starting 1 April 2015) we expect the DNOs to start their projects as quickly as possible, in compliance with the terms of their project direction and the Low Carbon Network Fund Governance Document.

3.4. We will monitor projects to ensure they are implemented in line with the full submissions. Each DNO will have to provide a detailed report, at least every six months, to allow us to evaluate the project's progress. We will publish the reports on our website to make project learning available to all interested parties. All DNOs should also share what they learn according to the plan in their project submissions. In addition, DNOs must hold an annual conference, open to all, where they present the learning from their projects. Finally, the Energy Networks Association has developed a portal which holds learning from innovation projects, including from the LCN Fund and the Gas and Electricity NICs.[9] We expect learning from this year's projects to be made available through the portal.

3.5. There is an extra incentive for DNOs to deliver the projects to a high standard. They will be eligible to apply for a reward if they meet the successful

[7] The funding DNO is the DNO which receives the approved funding and is responsible for ensuring the project complies with the project direction.
[8] We explain this fully in the funding direction, which we will publish on our website in January 2015.
[9] You can see the portal here.

delivery reward criteria in the project direction. The successful delivery reward is designed to reward those projects which are well managed and completed at least to the standard that could be expected from the full submission.

## Future competitions

3.6. This was the final year of the LCN Fund competition. From 2015, under the RIIO-ED1 licence, DNOs will be eligible to compete against Transmission Owners and Offshore Transmission Owners for Electricity NIC funding. This competition has similar arrangements to the LCN Fund. The full details are set out in the Electricity NIC Governance Document.[10] We may update these arrangements to incorporate lessons learnt from this year's process. The Electricity NIC Governance Document (version 2) will govern the third year of the Electricity NIC. This will be in place before the ISP deadline in 2015.

3.7. We will confirm the ISP and Full Submission deadlines for the Electricity NIC early in 2015. We expect them to be similar to the deadlines in 2014.

3.8. As explained in chapter 2, we had some concerns about certain areas of this year's submissions. We expect DNOs to consider these concerns when developing proposal for future Electricity NIC competitions.

3.9. The expert panel has also provided its views on potential improvements for submission to future competitions in section four of its recommendations report. Bidders in future competitions should take these points into account when developing their submissions.

## Existing LCN Fund projects

3.10. After this year, there will be no new LCN Fund projects. An updated licence condition and version of the LCN Fund Governance Document will govern the delivery of the existing LCN Fund projects – including those funded this year. These will be included as part of the RIIO-ED1 licence.

3.11. As existing LCN Fund projects conclude and are incorporated into standard business practice, we will have a better idea of their value to the industry and to customers. We will review LCN Fund projects outcomes and benefits in 2016. The results of that review will also inform the levels of funding available under Electricity NIC in the future. We will consult on the scope and methodology of our review next year.

3.12. It is critical that network companies disseminate their learning, implement successful innovations (regardless of who conducted the trial) and document the benefits of the scheme to justify the levels of customer investment.

[10] You can find the Electricity NIC Governance Document here.

# Appendix 1 – Project Evaluations

This appendix contains our detailed assessment of each project against the LCN Fund evaluation criteria. The governance document explains the evaluation criteria, our evaluation process and the terminology in full, but here is a summary -

| **Degree to which the solution being trialled:** | **Degree to which the project:** |
|---|---|
| • accelerates the development of a low carbon energy sector & has the potential to deliver net financial benefits to future and/or existing customers,<br>• impacts on the operation of the distribution network,<br>• provides value for money to distribution customers, and<br>• generates new knowledge that can be shared amongst all network operators. | • demonstrates a robust methodology and readiness of the project,<br>• is being delivered cost effectively,<br>• involves other partners and external funding, and<br>• is relevant and timely. |

## Fault Level Active Response (Electricity North West Limited)

### Project overview

Fault Level Active Response (FLARE) would trial three methods for managing fault currents in real time – two technical methods and one novel commercial arrangement.[11] If successful, the methods could increase fault level headroom across the high voltage and extra high voltage networks.

Currently, DNOs manage faults by isolating the section of network where a fault has occurred using circuit breakers. DNOs must ensure that their circuit breakers and other network infrastructure are designed to withstand the maximum fault current that could potentially occur on that section of the network. This potential maximum fault current increases as more customers – both demand and generation - connect to the network and as existing customers' electricity usage increases.

If the maximum fault current rises above the equipment's rating, the DNO has to replace its equipment with components that can withstand a higher fault current. These upgrades can take many months and can be expensive.

FLARE would investigate three techniques that could avoid these upgrades –

- **Adaptive protection** – would configure circuit breakers to trip in a particular order so that no single circuit breaker would be required to clear the entire fault current. This would allow DNOs to continue to use existing circuit breakers, even after the potential maximum fault current has risen above their rated capability.

- **Fault current limiting service** – would investigate new commercial arrangements for contracting industrial and commercial customers to trip off equipment when there is a fault. This will prevent these sites from contributing fault current and so help lower the potential overall fault current.

- **$I_s$-limiters** – would rapidly operate in a substation before a fault current reaches its potential maximum, and so reduce the through fault current on cables.

FLARE would aim to deliver a Fault Level Assessment Tool that could be used to proactively identify dangerously high potential fault currents on the network and automatically enable an appropriate mitigation technique from the range of available options.

Another LCN Fund project, WPD's second tier FlexDGrid, has previously been funded to investigate fault level mitigation techniques. While the two projects are considering the same issue, they each propose different techniques to deal with the problem.

[11] Fault current is the surge in current that happens when a fault arises on the network – it is several times the level of normal currents and can be very damaging to network equipment.

**(a) Accelerates the development of a low carbon energy sector & has the potential to deliver net financial benefits to future and/or existing customers**

This project would have the potential to accelerate the development of a low carbon energy sector by proving methods that would release network capacity that is currently constrained by the potential fault levels. This in turn would enable LCTs to connect more quickly and at lower cost.

*Low carbon benefits*

This project would have the potential to contribute to the Carbon Plan by releasing capacity for new renewable generation connections and LCT driven load growth.

The submission states that the project could release up to 127,275MVA if the methods were rolled out across the whole of GB. The rollout case is based on load forecasts using DECC's medium scenario 1. These forecasts suggest that the equipment at 67% of primary substations and 57% of bulk supply points (BSPs) across GB will have equipment rated at or below the maximum fault current level by 2050. This means that FLARE could be applied to up to 2131 primary substations and 310 BSPs by 2050.

The submission states that the methods could release this capacity up to 18 times quicker than the current best method -

- The adaptive protection and fault current limiting service methods could be installed in approximately 20 working days compared with an average traditional reinforcement time of 390 working days.
- The $I_s$-limiter method would take approximately 90 days to install.

We note that the installation times of the methods are estimates and would be tested in the project. Nevertheless, there is clear potential for the proposed methods to release the stated capacity more quickly than traditional reinforcement.

*Net financial benefits*

We consider it reasonable to expect that the methods could deliver the solution at lower cost than the most efficient existing method. ENWL estimates that the financial benefits across GB could be up to £2.4 billion by 2050. These benefits would flow back to existing customers and connecting customers through reduced reinforcement costs.

ENWL calculated the potential financial benefit of each method by comparing the costs of each method to the cost of traditional reinforcement. The submission estimates the cost of traditional reinforcement for the trial area (comprising seven primary substations and 2 BSPs) to be £6.14 million. ENWL included in its submission costs for each of the methods. Although the cost of each varies, all three have the potentially to release the same capacity as traditional reinforcement more cheaply.

Adaptive protection is the cheapest method and the $I_s$-limiter is the most costly. The full cost of the fault current limiting service will depend on the level of payments made to service providers. The project would seek to establish which technique is most appropriate to which network circumstances and, on the basis of this, establish what the most appropriate mix of techniques would be.

When extrapolated across GB using DECC's LCT forecasts, this indicates a potential range of benefits from £996 million to £2.4 billion in avoided reinforcement costs by 2050. In the resubmission, ENWL suggested that the benefits could be even higher. This was based on further analysis of the potential benefits of using $I_s$-limiters to protect (and defer reinforcement of) high voltage cables. This project would develop the use cases for each of the FLARE methods and establish a buy-order of interventions (including the FlexDGrid solutions). This would allow DNOs to identify which method would be most cost efficient, in which scenarios, and also more firmly establish the potential benefits of rolling out the FLARE solution across GB.

**(b) Provides value for money to distribution customers**

We consider that the project's cost is justified compared both with the potential financial benefits and the learning it could deliver.

ENWL estimates that if the project is successful, the total savings could be £2.4 billion by 2050. This is compared with a funding request of £4.57 million (and a total project cost of £5.75 million).

The project also has the potential to generate significant new learning. The proposed solutions are untested and unproven at the scale, or in the context, the DNO would seek to trial them.

- **Adaptive protection** has never been applied to distribution networks in GB before. This project would seek to prove that the technique can be used safely to release network capacity that would otherwise require reinforcement.

- The **fault current limiting service** trial would seek to establish the feasibility of a new form of commercial arrangement between the DNO and industrial and commercial network customers.

- **$I_s$-limiters** are not currently deployed on the GB network although they are used in other countries. This method is required to help develop the safety case for using $I_s$-limiters on the GB network.

We are satisfied that these methods complement (rather than duplicate) the methods being developed by FlexDGrid and, therefore, consider that this project could deliver additional value for money. The new knowledge that FLARE would generate, in addition to FlexDGrid, is assessed below under criterion (c) 'generates knowledge that can be shared amongst all DNOs'.

ENWL provided evidence through the process such that we are satisfied that appropriate procurement procedures have been followed to deliver the learning and benefits at a competitive cost.

We are broadly satisfied that the rates for the project partners and suppliers represent good value for customers.

**(c) Generates knowledge that can be shared amongst all DNOs**

Fault current management is a challenge faced by all DNOs. This project could extend and enhance the tools available to DNOs for managing fault current on their networks.

The project builds on learning from the ENWL First Tier project 'Fault Current Active Management' (FCAM) and would complement the learning from the WPD FlexDGrid project, which is also exploring fault current management techniques. FLARE would trial and demonstrate three further techniques that have not been trialled elsewhere in GB.

We note that FLARE has committed in Successful Reward Delivery Criteria (SDRC) 9.3.4 to deliver a tool for identifying the most economical available fault level management technique under given circumstances. The Fault Level Assessment Tool to be demonstrated by FLARE would be compatible with the techniques already being developed by FlexDGrid, as well as the methods to be trialled by the FLARE project. We consider that collaboration between the two projects would, therefore, be very important to maximise the learning from both. We note that ENWL has undertaken to collaborate with WPD to ensure that the outputs of FLARE and FlexDGrid would be aligned.[12] The FLARE project would also develop and disseminate the full technical specifications required by the other DNOs to integrate a Fault Level Assessment Tool into their own network management systems. This commitment is captured in SDRC 9.1.3 and 9.1.4.

The project would also develop template commercial contracts with the project participants for the fault current limiting service. These templates would be available to other DNOs, along with survey data, to assist in rolling out the service across their own networks as described in SDRC 9.2.4.

A detailed and appropriate learning dissemination plan is included in the submission. The dissemination products are clearly defined and linked to project milestones with ownership assigned to relevant project partners. This gives us confidence that the new knowledge generated through the project would be shared effectively with the relevant stakeholders.

The submission states that the project would conform to the default intellectual property rights arrangements.

[12] See ENWL's response to Q&A question 27.

**(d) Involvement of other project partners and external funding**

The project has a range of project partners with appropriate expertise for the project. These partners were identified through an open and competitive process. PB Power and Impact Research will provide the project with technical and analytical expertise. In addition, CHPA, ENER-G and United Utilities will provide customer engagement support and access to their members for the fault current limiting service tests and survey. Schneider Electric will provide the fault current limiting service.

ENWL has engaged with these partners already and has agreed external funding from a number of them. We are pleased that the project partners have agreed to make a contribution to the cost of the project. We note that United Utilities, CHPA and ENER-G's members would potentially benefit from the commercial proposition of the fault current limiting service, if it is proven successful.

Together, the project partners are contributing to the project in discounts and in-kind service. In total, they are contributing £515,000; almost 10% of the total project cost. While the contracts are not yet finalised, we are satisfied that the partners have been sufficiently engaged in the project and this external funding can be considered adequately secure for this stage of the project.

**(e) Relevance and timing**

We view this project to be relevant and timely. Capacity on the network is already constrained in some areas by fault current levels. If proven effective, the proposed solutions could realistically be rolled out into business as usual once the project is completed.

As the uptake of LCTs accelerates and more devices connect to the network, the problem of rising fault currents will continue to grow. When this happens, the relevance and potential benefits of the proposed solutions will increase.

**(f) Demonstration of a robust methodology and that the project is ready to implement**

We consider this project is robustly designed and ready to implement. The DNO submitted a robust project proposal with a well-developed project plan, allocating appropriate resource to each task. The submission also includes a detailed risk register with appropriate risk mitigations. The detail in the submission gives us confidence that the project could be started in a timely manner.

We noted in the customer impacts section that this project would involve the DNO recruiting at least one commercial demand and one commercial generation customer to test the fault current limiting service. The DNO would also survey a range of industrial and commercial customers to assess the potential interest in the service. The project partners, ENER-G, United Utilities and CHPA, would help to ensure that

potential participants will be approached appropriately. We note that this project would not affect the likelihood of faults occurring and customers losing supply. We are also satisfied that the DNO has considered, and would properly manage, the other potential impacts of this project on customers.

The SDRCs proposed in the submission are specific, measurable and linked to the project plan. The evidence proposed would appear to be appropriate to demonstrate the progress of the project and provide useful outputs for other DNOs replicating the project in future.

The project has not requested any protection against cost overruns. The project budget includes 7.2% contingency to cover against changes in the projected costs. We are satisfied the DNO used a reasonable methodology for estimating the costs and benefits included in the submission. The DNO assessed the rollout case for the solutions against the DECC carbon budget scenarios to establish upper and lower bounds of the solution's applicability.

A satisfactory project management approach was described in the response to the consultant's interrogation report. We consider that the proposed approach would provide the project steering group with the necessary information to make a reasonable decision to halt or continue the project if a critical issue were to arise, for example, if it became evident that the project benefits could not be realised.

## Kent Area System Management (UK Power Networks)

**Project overview**

This project would seek to address the operational and planning challenges that are arising from large amounts of intermittent solar PV and wind generation connecting to the distribution networks. Kent Area System Management (KASM) would seek to trial Contingency Analysis – a software tool that could improve DNOs' ability to manage their 132kV networks in the face of these challenges.

Contingency Analysis is a tool for analysing power flows and network conditions in real time and under a range of potential scenarios. It could help DNOs understand the effects of changes to their networks and identify actions that will keep them operating safely and securely, while also getting increased utilisation of the existing assets. UKPN expects the Contingency Analysis software tool to support the following activities –

- **Reliability management** – the tool would allow DNOs to more effectively manage the risks and impact of unplanned outages. The software would monitor the network in real time and constantly analyse potential contingencies, identifying preventative actions to control room engineers. This information would allow engineers to configure the network to be more resilient and reliable.

- **Outage management** – the tool would allow DNOs to reduce generation constraints during planned outages for maintenance and upgrades. The software would assess the likely network conditions during planned outages, and forecast demand and generation to determine the best network configuration and available capacity. By forecasting likely demand and generation, the tool would allow planners to move away from 'worst case' scenarios and run the network closer to its true capacity.

- **Network capacity planning** – the tool would enable DNOs to better understand how the existing network is actually being used and, therefore, better understand when and where new capacity will be needed. The tool would carry out advanced analysis of the historical operation of the network. Using this analysis, network planners would be able to make better informed investment decisions potentially deferring reinforcement.

**(a) Accelerates the development of a low carbon energy sector & has the potential to deliver net financial benefits to future and/or existing customers**

The project could accelerate the low carbon energy sector by reducing the constraints placed on renewable generators during outages and releasing capacity for

new renewables to connect. If successful, the project would allow the DNO to achieve this while reducing costs and deferring spending on new network assets.

*Low carbon benefits*

UKPN states that Contingency Analysis would inform its long-term capacity planning. It notes that current network planning practices are based on accommodating peak load, even where this peak only occurs for a few hours and the network would be underused for the rest of the year. The submission states that Contingency Analysis would enable DNOs to use their network management techniques more effectively to unlock some of the unused capacity and defer investment in new infrastructure. Specifically, UKPN states that KASM could release enough capacity to accommodate two years' worth of new connections in the East Kent area, at the current rate of 100MW of new connections per year.

The submission explains that Contingency Analysis would also help to reduce the impact of interruptions experienced by existing renewable generators caused by network outages. DNOs currently assume worst-case scenarios when planning outages for maintenance or planning contingencies for unforeseen outages. In other words, they assume that the network will be under the maximum amount of strain. Based on this assumption they prevent existing generators from exporting electricity to the network - to make sure that the system continues to function safely and reliably.

UKPN believes that the worst-case scenarios it has to assume do not reflect the actual state of the network. As a result, it is probable that in some cases generators are constrained unnecessarily. The submission states that Contingency Analysis would allow DNOs to better understand and forecast the conditions on the network and to plan contingencies that accurately reflect these conditions. UKPN expects that this would result in generators being constrained less often than is currently the case. This would result in financial benefits for the generators. It would also avoid the $CO_2$ emissions of the traditional generators brought online elsewhere to cover the reduced generation from the constrained renewable generators.

*Net financial benefits*

We consider that there is a reasonable expectation that the solution proposed by KASM would deliver financial benefits.

The financial benefits case set out in the submission is threefold. First, the submission states that Contingency Analysis would allow the DNO to constrain generation customers less often, reducing the lost revenue. Second, the submission states that Contingency Analysis would allow the DNO to operate the network closer to its maximum capacity, and so defer investment in new network assets. Third, UKPN states that using more advanced software would reduce pressure on the outage planning teams and save labour costs each year.

UKPN has calculated these three benefits of using Contingency Analysis to plan and operate the East Kent network as –

- £2.1 million in avoided lost revenue and carbon emissions reduction from reduced constraints on distributed generation customers over the three-year project.
- £1.1 million saving from deferring £9.7 million investment in a new super grid transformer at Richborough for two years.
- £0.2 million in reduced outage planning labour costs over the three-year project.[13]

This results in a total benefit of £3.4 million.

UKPN estimates that Contingency Analysis could be used to defer investment in 3 sites per year between 2020 and 2030 across the whole of GB. The submission states that this is a conservative estimate – the analysis in the submission shows that the actual figure could be as many as 8 sites per year. Assuming that the same benefits as modelled for the East Kent network can be realised in other areas, UKPN calculates that this would deliver a gross NPV benefit of £79.5 million across the whole of GB by 2030.

The cost of the trial in East Kent would be £3.9 million and the submission calculates that the costs of replicating the project would be £2.3 million for each of the six DNOs. The cost of implementing the software solution would be one off for each DNO. Therefore, the costs of rolling out the solution across GB would be £13.8 million – compared with the gross potential benefits of £79.5 million. The net benefits would, therefore, be £65.7 million.

**(b) Provides value for money to distribution customers**

While the potential benefits of the project are £3.4 million in East Kent compared with a funding requested of £3.35 million, the learning from this project could unlock net benefits of £65.7 million by 2030, if the solution is rolled out. We therefore consider that this project provides value for money to distribution customers. However, the adoption of the software tool by other DNOs will be key to value being maximised (see also criterion c).

The learning from KASM would be relevant and useful to other DNOs, providing them with a means of understanding their networks better, improving their outage planning management and using their existing assets more efficiently. The better understanding of the network that Contingency Analysis would enable would provide an important step along the path to DNOs controlling their networks more actively.

We are satisfied that the DNO has taken appropriate steps to ensure this project could be delivered at a competitive cost. UKPN followed an open and competitive procurement process to identify a supplier for the software. The outcome of this process was to appoint Bigwood Systems. We note that Navigant Consulting will provide specialised input to this project and that this is reflected in its fees. We are satisfied that the day rates of project partners and contractors are appropriate for the personnel committed to the project and the volume of work that will be undertaken.

[13] These figures are discounted to 2014 net present values.

**(c) Generates knowledge that can be shared amongst all DNOs**

Providing and maintaining network access to increasing levels of embedded generation is a challenge that all DNOs face. If successful, this project would provide DNOs with a new tool to help them meet this challenge.

UKPN states that this project is needed to develop the functional specification for using Contingency Analysis on GB distribution networks. UKPN notes that while Contingency Analysis is used at transmission level, it is often used in conjunction with the dispatch of generation. In this project, the Contingency Analysis would be used differently. UKPN states that this means there is no off-the-shelf Contingency Analysis product suitable for the distribution networks in GB. UKPN engaged with the Contingency Analysis provider, Bigwood Systems, National Grid and some of the other DNOs during the bid preparation stage to capture any relevant learning from previous applications. UKPN concludes in its submission that there are very limited examples of the Consistency Analysis tool being used in the proposed way by DNOs globally. Nevertheless, UKPN would engage with National Grid, a project partner, throughout the project to obtain relevant learning from its experiences with Contingency Analysis. This would include drawing on National Grid's experience of forecasting wind and solar output based on weather predications.

The expert panel expressed concern that the benefits case of this project is relatively modest and noted the importance of other DNOs being able to replicate the solution efficiently. We consider therefore that UKPN would need to engage with other DNOs throughout the project to ensure that they get the maximum learning from the project and are able to implement the solution smoothly and cost-efficiently into their own systems, if the project is successful. We note that UKPN commits in its SDRC to report on the project's engagement with the other DNOs on the technical and commercial aspects of establishing the inter-control room link with National Grid and integrating the Contingency Analysis into existing systems.

In addition, Bigwood Systems has committed to provide the Contingency Analysis solution at an equivalent price to all the other DNOs. The project would also make available to the DNOs any source code developed through the funding of the project required to integrate the Contingency Analysis software into their IT system. This would also include any detailed designs and technical and functional specifications developed by the project. The extent to which this source code would need to be developed further by each DNO would depend on the compatibility of their systems with UKPN's.

We consider that it would also be important for UKPN to ensure that an understanding of Contingency Analysis and its uses is embedded within the relevant teams as part of the project. This would help to ensure that the solution would be ready to be taken up as business as usual at the end of the project. The submission states that control room engineers would be trained to use the software as part of the project and their feedback would be used to refine the solution. Furthermore, the dissemination materials would also include training documents and user manuals.

The learning dissemination plans presented in the full submission seem sufficient to suggest that the project's outcomes would be well communicated to relevant stakeholders. While the plans are generic, the submission identifies an appropriate range of dissemination methods and target audiences. We note that the project plan includes a workstream for developing a complete learning dissemination road map at an early stage of the project.

The full submission states that this project would conform to the default intellectual property rights arrangements.

**(d) Involvement of other project partners and External Funding**

We consider the project partners to have the necessary relevant experience to add value to the project.

The project partners are Bigwood Systems, National Grid and Navigant Consulting. Bigwood would provide the Contingency Analysis tool. Bigwood has experience in this area and has provided IT solutions to large utilities overseas. National Grid would be an important partner in this project. National Grid already holds much of the information that would be needed by the Contingency Analysis software. UKPN acknowledges in the submission that establishing the communications link with the National Grid control room in a timely manner is a crucial step in delivering this project and that this will need to be carefully managed. Navigant would provide project management support and would advise on the development and integration of the software and supporting business processes.

We note that National Grid and Navigant would provide a combined £40,000 of in-kind contributions to the project. UKPN would contribute £72,000 over and above its compulsory contribution.

**(e) Relevance and timing**

We consider this project to be relevant and timely. The project would address the problem of managing power flows effectively in areas of high LCT penetration. Solar PV and wind are already present on the GB distribution network and are becoming more widespread.

If the use of Contingency Analysis is successful in enabling DNOs to manage power flows more effectively and reduce the number of constraints placed on the distributed generation customers, it is reasonable to expect that this solution could be adopted as business as usual as soon as the project is complete.

**(f) Demonstration of a robust methodology and that the project is ready to implement**

The KASM submission demonstrates a robust project methodology and provides us with confidence that the project is ready to implement.

The submission includes a detailed project plan, allocating appropriate resource to the project, as well as a well-developed risk register with appropriate mitigations identified.

We consider the risk of customers being adversely affected by this project to be low. If the project is successful, existing DG customers will experience fewer hours of constraint.

We are satisfied that the cost estimates in the submission are well evidenced and based on quotations from prospective software suppliers and discussions with project partners. The project has requested protection against cost overruns of up to 5%. However, the governance arrangements described seem adequate for mitigating against cost overruns. Similarly, the governance arrangements, including risk monitoring and senior management oversight, would allow the project steering group to make an informed decision to halt the project if the need arose.

The methodology for calculating the potential benefits of the project appears to be robust. The benefits case is based on the DNOs' long term development statements to understand the number of grid supply points (GSPs) likely to become constrained in the future across GB and therefore require reinforcement. The partners modelled the East Kent area to estimate the effect of using Contingency Analysis on the status of the GSP. By applying the effect to the GB GSP population the partners estimated the number of GSPs that would benefit from the solution.

The proposed SDRC are specific, measurable, realistic and linked to the project plan.

## Low Energy Automated Networks (SSE Power Distribution)

**Project overview**

Low Energy Automated Networks (LEAN) would seek to demonstrate a new technique - called Transformer Auto Stop Start (TASS) - for reducing fixed electrical losses from transformers on the 33kV/11kV distribution networks. TASS would involve switching off one of a pair of transformers when the electrical load falls below a threshold value. When the load rises above the threshold, TASS would switch the second transformer back on.

Substation transformers have not historically been operated in this way. This project is therefore needed to understand the impact of TASS on the transformers and network operation.

TASS would trial three options for switching the second transformer off when load is low and back on when load increases –

- **Option 1** – Would use existing switchgear to enable operators to remotely switch off the transformer. This would be a low cost option suitable where one of the pair of transformers could be switched off for longer durations.
- **Option 2** – Would use new advanced local control to operate existing switchgear for de-energising one of the transformers. The advanced local control would help to mitigate the impact of inrush currents and would be suitable where supply integrity may be at risk because of frequent switching of transformers.
- **Option 3** – Would use new advanced local control to operate new high-performance switchgear. This option would be suitable where the frequency of switching and magnitude of inrush currents may interfere with supply integrity, power quality or asset condition.

The three options are progressively more expensive but likely to be suitable in different circumstances. The project would establish which technology would be most cost effective in which situations. It would also test the impact of each of the options on network operation, asset life, power quality and noise levels. This knowledge would be captured by the project and incorporated into a Network Losses Reduction Tool to help distribution network operators (DNOs) determine where to deploy TASS and which option to use at a given site.

LEAN would also aim to demonstrate that network resilience can be maintained by 'interconnecting' substations where one of the pair of transformers have been switched off. This complimentary secondary method – called Alternative Network Topology (ANT) – would only be applied in conjunction with TASS to maintain resilience.

**(a) Accelerates the development of a low carbon energy sector & has the potential to deliver net financial benefits to future and/or existing customers**

This project would help to accelerate the development of a low carbon energy sector by reducing fixed electricity losses from transformers. This would produce both financial savings for customers and reduce carbon emissions attributed to the transport of energy through the distribution networks. Because ANT would only be deployed alongside TASS, the benefits of both are accounted for together in the business case.

*Low carbon benefits*

LEAN would have the potential to facilitate the carbon plan by proving a novel operational practice for reducing fixed losses. Fixed losses are the losses associated with keeping a transformer energised, and are not related to the power flowing through the transformer.[14]

Most substations at this voltage have at least two transformers, each rated to the substation's maximum load. This ensures there is no loss of supply if one transformer is out of service or if demand is unusually high. Under existing operational practice, both transformers are switched on all the time, even when load is low and both transformers have low utilisation. SSEPD suggests that during these periods of low load, one of the two transformers could be safely switched off to reduce fixed losses.

SSEPD estimates that TASS could save 90MWh annually at each substation it is applied to. When applied to all substations with low utilisation across GB this could equate to a saving of up to 1.5 TWh of electricity over 45 years, reducing $CO_2$ emissions by approximately 307,000 tonnes – this is based on applying TASS to 30% of 33kV/11kV substations.

*Net financial benefits*

In addition to the carbon benefits, LEAN could deliver modest financial benefits directly to customers. Suppliers must purchase additional electricity to compensate for electricity lost due to network losses. The cost of this is passed to all customers via their electricity bills. By reducing the amount of electricity lost, this project would potentially reduce these additional costs passed to customers.

SSEPD calculates that the cheapest option (Option 1) could be applied cost effectively to approximately 30% of 33kV/11kV substations. If the solution is proven and rolled out across GB, the total lifetime cost of this option would be approximately £17 million. SSEPD calculates that this could provide total net benefits of up to £49 million in present value terms over 45 years.

[14] These are as opposed to variable losses which increase as the load on the transformer rises.

SSEPD expects that some sites would require more expensive local control and switching equipment (ie Option 2 or 3), which would increase the cost and could reduce the overall financial benefit achieved. The submission shows that TASS Options 2 could be applied to 24% of sites while still delivering net financial benefits and Option 3 (the most expensive option) could be cost beneficial when applied to 5% of sites. The project would establish which technology options would apply best under which conditions and develop a complete business case for each across GB. Based on its analysis, SSEPD suggests that rollout across GB could deliver up to £49 million in savings to customers, although the figure would depend on how many times each option was applied. The project would aim to confirm the expected costs and benefits.

If successful, this project would provide a solution that could deliver net financial benefits in excess of £40 million over 45 years.

**(b) Provides value for money to distribution customers**

We consider this project to represent good value for money to customers and believe it is suitable for LCN Funding. The project would cost customers £2.67 million. If successful, the methods have the potential to reduce the $CO_2$ emissions attributed to the distribution networks. While we note that the total reduction in $CO_2$ emissions would be modest, we also note that the total electrical losses from the distribution network are significant. We therefore consider that a method for reducing these losses would represent good value compared with the cost of the project to customers.

We consider this to be an innovative project. While the technologies that would be deployed as part of each option are proven, the operational practice of turning distribution transformers on and off to reduce fixed losses has not been attempted before in GB. Distribution network transformers are typically kept on at all times, except for maintenance or when there is a fault on the network. As such, the impact of TASS on power quality and asset health is not understood.

This project would be unlikely to go ahead without LCN Funding. We note that there is no strong financial driver for the DNOs to trial this type of technology on their networks. It will also be critical to demonstrate to all DNOs that TASS does not negatively impact on transformer asset health, before the method can rolled out into their businesses as normal practice.

SSEPD stated that it would carry out open and competitive procurement for the necessary equipment.

**(c) Generates knowledge that can be shared amongst all DNOs**

We are satisfied that this project would generate new learning that could be shared among all DNOs. Network losses are a key challenge that the DNOs face and they are all required to design, build, and operate their distribution system in a manner that can reasonably be expected to ensure that distribution losses are as low as reasonably practicable.

We consider the learning dissemination plans in the submission to be sufficient and appropriately detailed.

The learning from this project would provide DNOs with a new technique for reducing losses. It would also provide a Network Losses Reduction Tool - a model for assessing when and how each option could be used most cost effectively. The project would also establish a baseline understanding of the effect of the solution on transformer health, noise levels and power quality. The project would gather data on fixed losses, power quality and asset health. Existing monitoring equipment would enable the collection of power quality data. The DNO would engage with transformer experts and transformer manufacturers during the first phase of the project to determine the best methods of monitoring asset health. We consider that it would be crucial for SSEPD to engage with the other DNOs at an early stage. To have the confidence to roll out the solution on their own networks, the other DNOs would need to be satisfied with the metrics and data capture methodologies. We note that SSEPD commits it its submission to seek input from the other DNOs throughout the project and especially during the trial design phase.

The full submission indicates that this project would adhere to the default intellectual property rights arrangements.

**(d) Involvement of other project partners and External Funding**

SSEPD has not identified any project partners at this stage of the project and, therefore, the project does not have any external funding. SSEPD notes that this is a technical project that would be largely carried out by its own engineers.

For aspects of the project requiring additional technical experts, competitive selection would be carried out after funding is awarded. SSEPD would work with the appointed experts to identify the appropriate means of monitoring asset condition, to analyse the outputs of the monitoring and to disseminate findings of this analysis.

SSEPD has identified potential support through its stakeholder engagement activities and has already contacted a number of relevant parties who have expressed an interest in the project if it is funded. We note that it would have been useful to have had more evidence of transformer manufacturers' input during the full submission stage, given how critical the issue of asset condition will be to determining whether TASS is a viable technique for rollout.

**(e) Relevance and timing**

We consider this project to be very relevant and timely. If proven successful, the solution could be rolled out across GB within RIIO-ED1.

The project takes account of changes in technology. The submission acknowledges the EU Ecodesign Directive which requires all new transformers installed to be low-loss transformers. We are satisfied that the benefits claimed in the submission take this into account. SSEPD stated in its response to the consultants' interrogation report that at currently-projected replacement rates it would take 60-80 years to complete the roll out of low loss transformers across GB. This is because the Ecodesign Directive will only apply to new transformers – DNOs will not be required to replace their existing assets early. This project could, therefore, help to reduce fixed losses more quickly than the rollout of low loss transformers under the Ecodesign Directive.

**(f) Demonstration of a robust methodology and that the project is ready to implement**

While we are broadly satisfied that this project would be ready to implement, we note that it would have benefited from further work prior to full submission to better understand the potential risks to transformer health. This would have enabled the project team to more clearly articulate to us and the expert panel how the project would assess and quantify the risks through the trials.

We note that, in an initial phase of work, SSEPD would consult with transformer manufacturers, transformer specialists, other DNOs and academia to –

- Identify the best methods of establishing baselines for the transformer performance and health that could be tested against in the project.
- Evaluate potential sites for suitability to ensure that a range of transformer types/ages and load profiles are included in the trials.

We also note that this initial stage of work would be followed by a go/ no-go stage gate. SSEPD states in the submission that the project would not continue unless the work up to the stage gate had demonstrated potential net benefits without increasing the risks to asset health or security of supply. SSEPD explains that it would consult the other DNOs before continuing to the second stage of the project. SSEPD also states in its submission that it would present written evidence of this consultation to Ofgem.

Structuring the project in this way gives us some assurance that SSEPD would develop an appropriate trial methodology based on a fuller understanding of the potential risks before spending a significant amount of money on the trials. However, carrying out some of this work before full submission would have made the proposal stronger.

At full submission, the project plan was basic and provided limited detail. After resubmission the plan was more detailed, indicating key project tasks and milestones, and setting out appropriate timeframes for completion. The resource

committed appears to be appropriate. The risk register is adequate, detailing potential risks and suitable mitigations. We are also satisfied that the costs in the full submission have been reasonably estimated.

We understand that potential customer impacts such as noise caused by switching transformers on or possible power quality issues would be considered during the site selection process to minimise the potential impact on customers. We also understand that the project will monitor power quality at the sites to identify any power quality issues that may arise. Customer facing staff – such as local operational staff and emergency service centre staff – would be briefed on the project and response plans would be put in place.

The SDRCs proposed in the full submission are satisfactory. We consider that they would demonstrate the outcomes of the project and provide the relevant learning to the other DNOs.

## Network Equilibrium (Western Power Distribution)

**Project overview**

Network Equilibrium would seek to trial three methods for managing power flows and controlling voltages across a wide area of WPD's South West distribution network -

- Method one – **Enhanced Voltage Assessment** (EVA) – Would comprise two parts –
    - Part one would develop a tool to help DNOs develop a more detailed understanding of actual voltage profiles, and so available headroom, on their 11kV and 33kV networks under normal and fault conditions.
    - Part two would conduct a desktop study (using the new tool) to investigate whether the existing statutory voltage limits at 11kV and 33kV could be safely widened from ±6% to ±8% to release additional network capacity.
- Method two – **System Voltage Optimisation** (SVO) - would develop and trial new software for dynamically adjusting transformer settings in real time to optimise network voltage profiles over a wide area.
- Method three – **Flexible Power Links** (FPL) - would install and test one AC-DC-AC power electronic convertor (the FPL) on the 33kV network. The FPL would be used to connect two 33kV networks which cannot currently be connected because of recirculating currents, phase angle issues or fault level constraints. The FPL would give the DNO control over real and reactive power flows, and would be used in conjunction with the SVO to provide voltage control.

If proven, these methods would have the potential to release capacity for connecting LCTs, such as renewable generation and heat pumps.

**(a) Accelerates the development of a low carbon energy sector & has the potential to deliver net financial benefits to future and/or existing customers**

If successfully rolled out across GB, the methods trialled by this project could combine to release a significant amount of capacity, saving significant reinforcement costs while allowing renewable generation (and demand LCTs) to continue to connect to the network.

*Low carbon benefits*

The full submission states that the methods could release up to 11.3GW of capacity across GB for the connection of LCTs and renewable generation by 2050 –

- The **EVA** method could potentially release in excess of 2.7GW by successfully widening the 33kV voltage limits. The project would quantify the additional potential benefit of using the EVA advance modelling tool across GB. In addition, the project would explore the potential benefits of also widening the 11kV voltage limits.

- The **SVO** method could potentially release 7.1GW by enabling DNOs to dynamically control voltages across the network, enabling DNOs to tackle voltage rise and voltage drop more effectively, and allowing the connection of more renewable generation and low carbon demand while keeping network voltages within limits.

- The **FPL** method could potentially release 1.5GW by enabling separate 33kV networks to be connected, so that areas of high demand can be connected to areas of high generation without the need for upstream reinforcement.

The submission states that this capacity could potentially be released much quicker than with the best methods currently available. In the trial, WPD expects to release capacity using the EVA tool two years earlier than through traditional reinforcement. WPD expects the SVO and FPL methods - respectively - to release capacity 18 and 12 months faster than traditional reinforcement.

*Net financial benefits*

By releasing capacity, the Network Equilibrium methods could potentially save customers money in avoided reinforcement costs. WPD estimates that the gross financial benefits of rolling out the Network Equilibrium methods across GB could be up to £1.47 billion by 2050. This is based on WPD's assessment using existing network modelling software of the potential benefits in the trial area extrapolated over GB. These savings (if achieved) would accrue to the DNOs and would be shared with customers. New connecting customers would also potentially benefit through cheaper and quicker connections.

- The project would explore and quantify the benefits of using the **EVA** modelling tool and expanding the 11kV voltage limits across GB. The submission states that the EVA method would provide financial benefits of £9.9 million in the trial area by 2030. £2.8 million of this would be from trialling the advanced modelling tool and £7.1 million if the project successfully makes the case for widening the 33kV voltage limits. If rolled out to all 14 licence areas, widening the 33kV voltage limits could save customers £278.3 million by 2050.

- WPD's assessment shows that the **SVO** method could deliver benefits in the trial area of £25.9 million by 2030. WPD projects that by 2050 the SVO method could be applied to 28 similar size areas and deliver £739 million of savings in avoided reinforcement costs.

- WPD expects the **FPL** method to save £9.4 million in traditional reinforcement costs by 2030 in the trial area. Assuming that the FPL solution could be applied to 5% of the bulk supply points (BSPs) by 2050, WPD expects that the solution could deliver benefits of £448.7 million.

**(b) Provides value for money to distribution customers**

While we note that the cost of this project is high, we consider this project to represent value for money to customers. If the methods are successful, they could unlock 344MW of capacity in the trial area and deliver financial benefits of up to £45.2 million by 2030, compared with a funding request of £11.48 million. If the project is successful and the methods are rolled out, the financial return to customers could be considerable, as explained above under criterion (a).

We and the expert panel were concerned with the cost of this project when it was first submitted. We note that WPD reduced the scale of the FPL trial in its resubmission, reducing the requested funding for the project by approximately £3m. The project would now trial one FPL at 33kV, as opposed to one at both 33kV and 11kV. While the quantified benefits for the FPL, therefore, only include the rollout of FPLs to 33kV sites, WPD notes that the learning from this project would create a template for deploying FPLs in all cases (including at 11kV sites).

As discussed below under criterion (c), we are satisfied that this project has the potential to generate significant new knowledge that will be relevant to all DNOs. We therefore consider this project to represent good value for money when the cost is compared with the potential value of the learning.

We are satisfied that the project would be delivered at a competitive cost. The submission states that suppliers would be selected through a competitive tender process following the funding award. The project would contract four suppliers to help deliver this project. This includes a technical supplier for each of the three methods and specialist support in modelling, as well as engineering and design support.

**(c) Generates knowledge that can be shared amongst all DNOs**

As intermittent generation connects to the distribution networks, all DNOs will experience increasing voltage control issues and need to develop ways of managing voltages while also making efficient use of their existing assets. The methods that Network Equilibrium would seek to demonstrate could deliver a toolkit for achieving this, which could be used across GB.

We consider the methods proposed to be innovative as they have not been tried before in GB. We, also, consider that this project has the potential to generate significant new knowledge.

- The **EVA** method would develop a new tool for DNOs to more accurately model and understand the behaviour of voltages on the distribution network. It would also investigate the current 11kV and 33kV voltage limits to assess whether they are still appropriate – potentially making the case to widen the limits to release capacity.

- The **SVO** method would develop software algorithms to enable DNOs to dynamically control tap changes at transformer substations to optimise voltages across wide areas.

- The **FPL** method would trial the use of power electronics to connect two separate parts of the network at 33kV to help manage voltage. Although power electronics are being tested in another LCN Fund project, we note that this is at a lower voltage. If the FPL trial is successful, the learning could potentially also be applied to deploy power electronics to connect 11kV networks.

The learning dissemination plans presented in the submission are adequate. WPD outlines ten learning areas that it would address through the project and in the project reports. The learning topics are linked to the key pieces of knowledge that the other DNOs would need to replicate the solutions on their own networks, if they are proven successful. The plans also consider how learning will be disseminated more widely.

We note that it will be important for WPD to engage effectively with other DNOs and industry more widely throughout the project, to ensure that the evidence compiled to make the case for widening the statutory voltage limits is sufficient to convince the relevant parties.

The submission states that this project would conform to the default intellectual property rights arrangements.

**(d) Involvement of other project partners and External Funding**

At this stage WPD has not confirmed its project partners. As discussed above under criterion (b), WPD would select four project suppliers following the funding award. These suppliers would be selected on a competitive basis. The roles and responsibilities of the required suppliers are clearly described in the submission. We consider these to be appropriate for delivering the project. We note that WPD has already begun to engage with potential suppliers through a request for information. The project plan indicates that contracts would be confirmed by the end of June 2015.

WPD made some effort to attract external funding. WPD included an invitation to provide additional funding in its request for information from potential suppliers. It did not receive any offers and, therefore, this project does not include any external funding.

**(e) Relevance and timing**

We judge this project to be both relevant and timely. Maintaining voltages within statutory limits and within equipment ratings while making maximum use of network assets is a challenge faced by all DNOs and one which is increasingly difficult in the face of intermittent generation and changing demand profiles.

If proven, the solutions proposed by WPD could play a considerable role in DNOs' voltage management strategies. Even if the uptake of LCTs is lower than expected, the learning from this project would be beneficial to DNOs. By providing the DNOs with greater visibility and control over the voltages on their networks, the Network Equilibrium solutions could be deployed to facilitate general load growth and avoid future reinforcement.

**(f) Demonstration of a robust methodology and that the project is ready to implement**

We are satisfied that this project is robustly planned and ready to implement.

The submission includes a detailed project plan with sufficient resource allocated to each task. WPD also provided a risk register identifying relevant risks and suitable mitigations against each. We are satisfied that the project planning is sufficiently advanced to ensure that the project could be implemented in a timely manner.

As part of the investigation of 11kV and 33kV voltage limits under the EVA method, the project would carry out a desktop exercise to determine whether there is any equipment being used by DNOs or customers that would be adversely affected by extending the voltage limits. The project would not seek to operate the network outside of the current limits, but would gather evidence to present the case for extending the voltage limits to the relevant government bodies. We do not consider that this project would have any direct impact on customers.

We are also satisfied that the costs and benefits of the project have been reasonably estimated based on costs indicated by potential suppliers and WPD's own experience of traditional reinforcement and previous LCNF projects.

WPD has confidence it its own costs estimates and has not requested any additional protection against cost overruns. The submission describes a suitable approach to identifying circumstances under which the project would be suspended. The approach includes regular reviews with senior management at key stages of the project to assess whether the project should continue. The review would be supported by

ongoing risk management and engagement between the project team and senior management.

The proposed SDRCs are acceptable. They identify specific outputs that are measurable and clearly linked to the project plan.