Low Carbon Networks Fund
Screening Submission Pro-forma

Notes on completion

Before completing this form, please refer to the LCN Fund Governance Document, which details in full the information that you are required to provide. Please use the default font (Verdana size 10) in your submission, the text entry areas are predetermined and should not be changed. The full-completed submission should not exceed 10 pages in total.

Ofgem will publish all the information contained within the Screening submission.

DNO Group

Western Power Distribution

Participant DNOs

Western Power Distribution: West Midlands, East Midlands, South West and South Wales

DNO area(s)

Western Power Distribution: South West

Project title

Equilibrium

Project summary

The DNO must provide an approximate Project start and end date.

This project seeks to address steady-state voltage management across wide areas and, simultaneously, power flow management and transient voltage management in constrained areas. The management of voltage (including voltage drop, voltage rise and voltage step change) is a growing issue with the integration of low carbon technologies for generation and demand. The constraints are exacerbated during outage conditions (maintenance, new connections and post-fault). Conventional solutions to manage voltage issues currently entail installing larger overhead lines and underground cables with significant capital costs and long lead times. Previous LCN Fund projects do not address the voltage management problem on a system-wide level.

Three new Methods will be tested and their applicability to 33kV and 11kV distribution networks in Britain assessed. Each will involve testing within South West England:

(1) Enhanced voltage assessments (EVA);
(2) Dynamic voltage control (DVC); and
(3) 'Soft Links' (power electronic converters).

This project aims to develop Solutions that facilitate more rapid and cost effective network connections for generation and demand customers. The Project will also demonstrate advanced power conversion technologies to improve the efficiency of transferring power, whilst supporting system stability and without significantly increasing fault level (short circuit current). The project will start in March 2015 and conclude in March 2019.

Estimated Project funding

The DNO must provide an approximate figure of the total cost of the Project and the LCN Funding it is applying for.

Total cost of Project	£21,445k	**LCN Funding requested**	£19,495k
Cross Sector Projects: Requested funding from Electricity NIC, Gas NIC or NIA?	If yes, please specify No		

Problem

The DNO must provide a narrative which explains the Problem(s) which the Project is seeking to address.

The UK has set carbon reduction targets to address climate change. The integration of low carbon technologies will deliver carbon savings across a number of sectors including electricity, heating and transportation.

The electricity infrastructure in rural locations was designed and developed for its former remote and light power distribution requirements. However, with the integration of significant levels of low carbon technologies (generation and consumption) voltage management and thermal issues can be encountered. These are best dealt with simultaneously through a system-level engineering approach. Further connections to the existing network will require voltages along feeders to be managed in real-time to accommodate the fluctuations in generation and demand. A system-level approach to voltage and power flow management will defer and/or avoid the costs associated with reinforcing the network to accommodate reverse power flows and enable DNOs to divert generated power from rural locations to larger demand centres.

In order to ensure the integrity of the power system, voltages and power flows need to be maintained within equipment ratings. At present, the assessment of a new customer connection is based on 'passive operation' of the electricity network, representing the most onerous operating conditions. This can lead to connection assessments which are necessarily conservative, based on the information available. However, passive design of electricity networks is not well-suited to accommodating high levels of intermittent generation. It is also becoming increasingly complex for DNOs to evaluate system operating regimes. For example, as the utilisation of distribution networks increases, operation under outage conditions (maintenance, new connections and post-fault) becomes more difficult.

This project seeks to address steady-state voltage management across wide areas and simultaneously, power flow management with transient voltage management in problem areas. The management of voltages is a growing concern with the integration of low carbon technologies for generation and demand. This was recently highlighted by the IET in their Power Network Joint Vision "Electricity Networks – Handling a shock to the system". These problems are exacerbated during outage conditions.

Conventional network reinforcement options generally involve the replacement of network assets (transformers, cables and overhead lines) with higher capacity components. These options often incur significant cost and may involve long lead times for installation, delaying the connection of customers to the network. For example, a recent outline offer to upgrade 33kV network components to release 7 MVA of capacity was estimated to cost in the region of £2.3m, taking between 18 months and three years to complete the works. Obtaining planning consent to build new overhead lines can further delay projects by months or years.

Method(s)

The DNO must describe the Method(s) which are being trialled. The DNO must outline how the Method(s) could solve the Problem. The type of Method should be identified where possible e.g. technical, commercial etc.

The problems outlined above will be addressed using three Methods, each of which is primarily technical in its focus. The Methods to be trialled are applicable to GB HV (mainly 11kV) and EHV (mainly 33kV) distribution networks:

(1) Enhanced Voltage Assessment (EVA);
(2) Dynamic Voltage Control (DVC); and
(3) Soft Links (power electronic converters).

The Enhanced Voltage Assessment Method will develop a forecasting and configuration tool to assist with load and generation planning, including network reconfiguration considerations. This will optimise system voltages and power flows when using the Dynamic Voltage Control and Soft Link Methods. This Method will also explore and challenge the assumptions that underpin the existing voltage standards to ensure they are still relevant, assessing whether modification could increase the ability to connect further generation and demand connections.

Method(s) continued

The Dynamic Voltage Control Method will develop and install novel equipment with the ability to monitor and control the distribution system voltage profiles downstream of eight Bulk Supply Points (BSPs: 132kV / 33kV), in real time, based on group demand, feeder demand and Distributed Generation output. This will allow the optimal voltage settings at BSPs and selected primary substations to be applied, based on real time power flows. This method builds on learning from earlier LCNF projects.

The Soft Link (power electronic converters) Method will install back-to-back power electronic devices to manipulate real and reactive power flows, on a dynamic basis, between previously unconnected networks. The Method will be trialled within 11kV and 33kV networks. These devices provide simultaneous power flow and voltage management capability and allow the power from one distribution system to be efficiently transferred to another. The devices will be installed between normal open points within existing substations to manipulate power flows between BSPs and primary substations. This will also allow National Grid system groups to be connected together at a DNO's network level, without significantly increasing fault level (short circuit current).

The project Methods aim to unlock and fully utilise the existing network capacity, using dynamic operation to allow increasing levels of generation and demand to connect to the existing distribution network more quickly and cost effectively.

Funding commentary

The DNO is to provide a commentary on the accuracy of its funding estimate. If the Project has phases, the DNO must identify the approximate cost of each phase.

This four year project will run in four overlapping strands of work:

Strand A (£1,975k) – Design, development and analysis – Further detailed design and development to de-risk the equipment installation phases and facilitate detailed network analysis.

Strand B (£3,885k) – Dynamic Voltage Control technology installation – Fitting monitoring and control equipment across the distribution network downstream of eight Bulk Supply Points (BSPs).

Strand C (£14,905k) – Soft Link technology installation – construction activities associated with the installation of Soft Link technologies.

Strand D (£680k) – Trial, analysis and evaluation – Results capture, analysis, evaluation and development of new standard approaches.

Learning outputs from this project will be disseminated to other DNOs and interested parties at regular intervals throughout the project delivery strands.

As with previous LCNF competitions, the project costs have been developed using a bottom up approach, based on WPD's schedule rates, indicative supplier quotations and the knowledge derived from previous projects.

Specific Requirements (please tick which of the specific requirements this project fulfils)

A specific piece of new (i.e. unproven in GB) equipment (including control and communications systems and software) that has a Direct Impact on the Distribution System)	√
A specific novel arrangement or application of existing Distribution System equipment (including control and communications systems software)	√
A specific novel operational practice directly related to the operation of the Distribution System	√
A specific novel commercial arrangement	

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

The DNO must demonstrate that the Solution makes a contribution to the Carbon Plan and has the potential to deliver financial benefits.

In line with requirements of the LCN Fund Governance Document, the DNO should provide the following to demonstrate compliance with this criterion:

i. How the proposed Project will make a contribution to the Carbon Plan. In particular the DNO should outline:
- *The aspect(s) of the Carbon Plan which the Solution(s) facilitates.*
- *The contribution the roll out of the Method(s) across GB can play in facilitating these aspects of the Carbon Plan.*
- *How the roll out of the Method(s) across GB will deliver the Solution(s) more quickly that the most efficient method currently in use on the GB Distribution System.*

ii. The financial benefits of the Method(s) being trialled. Financial benefits should be calculated as set out in Section Two, paragraph 2.13, of the LCN Fund Governance Document.

Contributing to the Carbon Plan

The Carbon Plan will deliver carbon emission cuts of 34% on 1990 levels by 2020. This national target is complemented by local government carbon emission reduction targets as set out in their strategy planning documents. The Carbon Plan sets out ways to generate 30% of our electricity from renewable sources by 2020 in order to meet our legally binding EU target to source 15% of the UK's energy from renewable sources by 2020.

The UK Government has identified distributed generation as a major low carbon energy enabler and an important part of the future electricity generation mix. By facilitating the more rapid and cost effective integration of low carbon technologies for generation and demand, this project will accelerate the development of a low carbon energy sector. The cost effective incorporation of Distributed Generation to the existing network is already becoming an issue in the most suitable areas. Innovative solutions from previous LCNF project have already proven their ability to optimise networks in a more cost-effective way than previous methods, whilst unlocking additional capacity. The Equilibrium Project aims to develop a similarly beneficial solution.

Potential to deliver net financial benefits

Indicative financial benefits of Equilibrium are outlined below. These have been calculated by estimating the costs of delivering the Solution (at the scale being tested within the Project) through the most efficient method currently in use on the GB Distribution Systems (the Base Case Costs) and comparing the Base Case Costs to the costs of replicating the Method, at the scale being tested in the Project, once it has been proven successful (the Method Costs).

Financial benefit of Enhanced Voltage Assessment Method: **£0.7m**

- This Method is also an enabler for the Dynamic Voltage Control and Soft Link Methods, and yields other benefits such as time savings when assessing customers' connections and provision of more accurate costs for customers' connections.

Financial benefit of the Dynamic Voltage Control Method: **£12.0m**

Financial benefit of the Soft Link Method: **£6.2m**

Total financial benefit of Equilibrium's Methods when combined as a suite*: £19.5m

- The total financial benefit of Equilibrium's Methods excludes the financial benefit of the Project to other stakeholders, such as prospective generation and demand connection customers.
- *When the Dynamic Voltage Control and Soft Link Methods are combined, additional system-wide benefits can be unlocked.

Has a Direct Impact on the operation of the distribution network

A Second Tier Project must demonstrate that the Method(s) being trialled will have a Direct Impact (as defined in the Governance Document) on the operation of a DNO's Distribution System.

The Enhanced Voltage Assessment Method will deliver a repeatable design tool, providing invaluable insight into the current and future state of the distribution network. This will have a Direct Impact on the operation of the Distribution System by informing DNOs of the most appropriate locations for DVC equipment and Soft Link technologies. This Method will recommend revised limits for voltage operation within the existing DNO standards. This will have a Direct Impact on the operation of the Distribution Systems allowing additional generation and demand connections before limits are breached.

The Dynamic Voltage Control Method will involve the installation of monitoring and control equipment in substations downstream of eight BSPs. This will have a Direct Impact on the operation of the Distribution System by allowing DNOs to optimise feeder voltages in real-time and under all operating conditions.

The Soft Link Method will involve the novel arrangement of converter technologies to provide links between 33kV and 11kV distribution networks within different BSPs or across existing normally open points. This will have a Direct Impact on the operation of the Distribution Systems by increasing the capacity of the network to transfer power from low carbon generation sources to demand centres deploying low carbon demand (such as electric vehicles and heat pumps).

When combined, all three Methods will increase the headroom for customer connections (generation and demand) and, as networks become more complex, the Methods will help DNOs to identify the most economic way to optimise the network configuration or provide increased capacity.

This project will directly facilitate additional network connection and optimise power flows at a local level, benefiting customers.

Generate knowledge that can be shared amongst all network operators

The DNO must explain the learning which it expects the Method(s) it is trialling to deliver. The DNO must demonstrate that it has a robust methodology in place to capture the learning from the Trial(s).

In line with the LCN Fund Governance Document, the DNO should provide the following to demonstrate compliance with this criterion:

i. How the Method(s) being trialled will generate new knowledge.
ii. What methodology will be used to capture results from the trial and disseminate that learning to all DNOs.

The Enhanced Voltage Assessment Method will generate new learning for DNOs. For example, by developing novel UK-wide DNO recommendations for Dynamic Voltage Control assessments and the modelling of Soft Link technologies between 33kV and 11kV networks. At present, all DNOs plan for the most onerous voltage and power flow conditions when assessing generation and demand connections as part of Business as Usual processes. By gaining a more in-depth understanding of the assumptions that underpin present DNO standards for assessing voltage deviations (drop, rise and step change), this will enhance network knowledge and allow assumptions to be verified and refined.

The Dynamic Voltage Control Method will build on the valuable learning generated by WPD's own LCN Fund projects, and others such as Northern Powergrid's "Customer-Led Network Revolution", Scottish Power's "Flexible Networks for a Low Carbon Future", Electricity North West's "Customer Load Active System Services" and UK Power Networks' "Flexible Plug and Play", as well as other UK projects. This will accelerate the Technology Readiness Level (TRL) of voltage control solutions through scaled trials at a system level.

The Soft Link Method will generate completely new learning, which can be shared amongst all network operators, regarding the integration and operation of the technologies within Distribution Systems. Particularly, the simultaneous management of voltages and power flows using power electronic devices.

The learning will be captured and disseminated using the same robust methodology that WPD has successfully employed.

Please tick if the project conforms to the default IPR arrangements set out in the LCN Fund Governance Document?	√

If the DNO wishes to deviate from the default requirement for IPR then it must demonstrate how the learning will be disseminated to other DNOs taking into account any potential constraints or costs caused by or resulting from the proposed IPR arrangements.

Not applicable.

Focus on Methods that are at the trialling stage

The DNO must demonstrate that the proposed Project would not be performed in the DNO's normal course of business.

In line with the LCN Fund governance document, DNOs should provide the following to demonstrate compliance with this criterion:

i. How the Method(s) being trialled are untested at scale and circumstance in which the DNO wishes it to be deployed.
ii. Why the scale of the Project is required to deliver the learning and why the Project would not have been an appropriate First Tier Project.
iii. Why it has not previously used this Method to solve the Problem (including where the Method involves commercial arrangements) and why LCN Funding is required to undertake it. This must include why it would not run the trial as part of its normal course of business and why the Solution is not R&D.

The proposed Methods are not currently available as part of WPD's normal course of business because:

(i) At present, Enhanced Voltage Assessment tools are not available and in wide-scale use by DNOs for modelling dynamic network conditions; The Dynamic Voltage Control Method has not been demonstrated on this scale (at eight BSPs) under both normal and outage network operation; The Soft Link technologies have not been demonstrated by DNOs, as operational devices, in the UK Distribution System. Multiple Soft Link technologies need to be trialled to avoid risks with single supplier projects and for diversity. Together, these Methods will help to accelerate the TRL of voltage and power flow management technologies, helping DNOs to gain confidence in the technologies and laying the foundation for new Engineering Recommendations and standards.

(ii) The proposed scale of Equilibrium is required to deliver a system-level Solution and system-level learning. Furthermore, the timescales required to procure and trial the technologies mean that the project would not be eligible for First Tier Project funding.

(iii) The project builds on R&D and other LCN Fund projects that have identified solutions to voltage and power flow management issues. Equilibrium's Methods will allow a system-level Solution to be implemented for normal and outage network operating conditions, delivering benefits to a much wider variety and number of customers; The Dynamic Voltage Control and Soft Link planning methodologies have not been developed and the technologies are not yet deployed in Distribution Systems; Prior to the increase in integration of low carbon technologies, driven by the Carbon Plan, there was not the need case to develop system-level generation and demand assessment methodologies, and to develop Dynamic Voltage Control and Soft Link Solutions at the Distribution System level.

Project Partners and external resourcing/funding

The DNO must provide evidence of how Project Partners have been identified and selected, including details of the process that has been followed and the rationale for selecting participants and ideas for the project.

The DNO should provide details of any Project Partners who will be actively involved in the Project and are prepared to devote time, resources and/or funding to the Project. If the DNO has not identified any specific Project Partners, it should provide details of the type of Project Partners it wishes to attract to the Project.

The following Project Partners have been identified at ISP stage:

- Project Development - Parsons Brinckerhoff (Project engineering, design, complex system integration and consultancy). Parsons Brinckerhoff was selected to assist with the project submission stage based on price and their capabilities in the areas of voltage and power flow management. Their team working on Equilibrium are already known to WPD engineers through their supporting role on WPD's FlexDGrid project. Further they have indicated their desire to devote time, resources and funding to the Project.
- Project Delivery – Engineering consultancy expertise will be fully defined prior to full submission and a competitive selection process carried out.
- Specialist modelling analysis and support (the types and level of support will be confirmed during preparation of the Full Submission Pro-forma).
- Academic partner – the need for an academic partner will be determined prior to full submission. Any support will be procured through a competitive process.

New technology vendors will be selected through a competitive process to deliver best value for money to customers and to ensure fair market prices. The equipment suppliers of new technologies have not been identified at this stage. However, the following supplier categories have been identified:

- Voltage and power flow monitoring equipment supplier(s);
- Voltage control equipment supplier(s);
- Power flow analysis supplier(s); and
- Soft Link equipment supplier(s).

For standard equipment, WPD will utilise existing framework agreements, using EU-compliant systems already in place to provide best value to customers.

Derogations or exemptions

The DNO should outline if they consider that the Project will require any derogations, exemptions or changes to the regulatory arrangements.

No derogations have been identified at this stage.

Customer impact

The DNO should outline any planned interaction with customers or customers' premises as part of the Project, and any other direct customer impact (such as amended contractual or charging arrangements, or supply interruptions).

This Project will not entail any interaction with customers or work on customers' premises. There are no direct customer impacts including supply interruptions.

The project will not prevent customers from applying for generation or demand connections. WPD will continue to provide customers with connection offers based on conventional solutions in the trial area until the Methods have been demonstrated and incorporated into company policies.

Details of cross sector aspects

The DNO should complete this box only if this Project forms part of a larger cross sector Project that is seeking funding from multiple competitions (ie Electricity NIC, Gas NIC or LCN Fund). The DNO should explain about the Project it will be collaborating with, how it all fits together, and must also add a justification for the funding split.

Not applicable.

Any further information the DNO feels may add to the submission
Not applicable.
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