Low Carbon Networks Fund: Screening Submission Pro-forma

Notes on completion
Before completing this form, please refer to the LCN Fund Governance Document. **The typeface, font size and colour for the text entry areas are predetermined and should not be changed. Please ensure all content is contained within the boundaries of the text areas. The full-completed submission should not exceed 6 pages in total.** **Ofgem will publish all the information contained within section 1.1 following the ISP deadline and we will publish the information contained within section 1, 2 and 3 following the Full Submission decision.**

Section 1: Project outline

1.1. Project summary

Project title
Impact of Renewable Generation Technology on Distribution Network Templates
Project purpose *Provide a narrative that explains the problem the Project, is seeking to address and the solution it is using to solve the problem. Detail how the project meets one or more of the specific requirements set out in paragraph 2.8 of the Initial Screening Process chapter of the LCN Fund Governance Document*
With the low-carbon future, DNOs need to prepare for new challenges, including: Substantial increase in electricity demand from electric vehicles (EVs) and heat pumps; increased deployments of distributed generation (DG); changed energy demand patterns from new energy efficiency measures inc. insulation and solar heating. The impact of these changes on the electricity network is uncertain and need to be understood fully before effective network redesigns can be made. Initial studies by Imperial have started to predict their impact and the changes required to support their deployment. This work has developed to the concept of network templates (e.g. city/town, semi-urban/rural, rural network) enabling common modelling across all distribution areas. WPD propose a project which will develop this work further by deploying and monitoring sensors in areas which will undergoing significant low-carbon redevelopment, namely The Western / Head of the Valleys and Cardiff in Wales, to: 1) prove that networks can be effectively characterised into different standard templates; 2) collect empirical data (Volts, VARs, quality) of energy patterns on each template type to provide real scenarios on which low-carbon connection (DG & EVs) can be modelled accurately; 3) collect empirical data on the networks ability to integrate the stresses of DG, electrification of heat and energy efficiency measures; 4) provide data on quantity of DG that is operating on the LV network to enable NG to improve their load forecasting and generation scheduling. WPD believe this project therefore meets the criteria “A novel arrangement or application of existing Distribution System equipment” and will provide necessary insights into the operation of the LV network to support changes required to meet future energy demands.
Estimated Project funding *Please provide an approximate figure of the total cost of the project and the LCN funding you are applying for*

Total cost of Project	£17m incl relevant WAG arbed projects + npower /LA CESP	**LCN funding requested**	£9.5 (excludes WPD contributions)

1.2. Additional Project details

Funding commentary

Provide a commentary on the accuracy of your funding estimate. If the Project has phases, please identify the approximate cost of each phase

The project costs are preliminary, but are based on evidence from commercial quotations, previous projects and cross checked against third party sources. Additional project funding sources are from Welsh Assembly Government (WAG) "Arbed" initiative , npower (CESP, CERT obligation) and Bristol University (EPSCR). The project will operate over 4 phases:

Plan / Design (£500k, Dec 10-Mar 11)- the project planning and design phase will categorise the network areas into the appropriate template types and identify the full scope of infrastructure required to effectively monitor the power flows and capture details of the new generation and energy devices installed and energy efficiency measures.

Network Sensor Deployment (£6.1m Regulatory Year 2011-12)-the deployment phase will see the installation of all (DNO) network equipment, and implementation of back office systems and processes.

Monitor (£9.2m, mid 2011- March 2013)-the monitor phase will collect data on energy usage , changes to the energy flows and cover the deployment of energy efficiency measures and new low carbon connections (DG) onto the network funded from Arbed £3.6m and npower CESP/ LAs £2.4m, EU SSEG Feasibility funding (€13m not counted).

Detailed Analysis (£1.2m, mid 2011-mid 2013) The detailed analysis phase will be supported by Bath University who will analysis the data and evaluate the impact across each of the network types (and on the original Imperial work). NG will be provided with the data to model the impact of DG on their demand forecasting and gen. scheduling. Bristol University will use the data to support their EPSCR project on modelling behaviour of smart grids.(£0.5m)

Project solution

Provide specific details of the solution which you are trialling, including details of specific network conditions where the trial is taking place

Network monitoring will be deployed to measure power (Volts, VARS) and quality across LV network template areas covered by 1200 substations in Central Cardiff and the Western / Head of the Valley region of South Wales. Low carbon connections will be introduced to the area through several mechanisms and their impact measured additionally through end of feeder sensors and Feed in Tariff (FIT) meters. It is expected that the network will be stressed by the new energy flows, however, the degree to which it will cope without reinforcement is unknown.

The connections will be created by the following schemes: The Welsh Assembly Government has identified this area as a target to be one of the largest low carbon zones in the UK. In particular, Aberdare has been selected to champion the latest renewable energy technologies and energy efficiency measures. The Government has committed £140m over the life of the programme with an additional £360m being provided by the private sector, including energy efficiency in 40,000 homes and installation of renewable technology in 300 homes (e.g. solar water heaters, heat pumps, air source heat pumps) during the first year. npower has committed to investing significantly in this area through their CESP obligations and targeted leveraging of additional funding for renewables. Cardiff has applied for the Plugged in Places scheme which is expected to see the introduction of EVs to this region.

The sensor data will be captured and stored within the ENMAC system. Its analysis will enable the impact of developing a lower carbon economy on the LV network to be clearly identified, to identify the headroom that is available within each network type and to enable accurate predictions of the amount of DG and energy efficiency measures that each network type can sustain before network reinforcement or "smart technology" is required.

In addition the data will be provided directly to NG to help identify the amount of embedded generation that is included within the network to help understand the impact on network system operations.

Section 2: Eligibility criteria

In the space provided below, please demonstrate below how your project meets all of the following eligibility criteria:

Accelerates the development of a low carbon energy sector

Demonstrate how the Project makes a contribution to the UK's Low Carbon Transition Plan, as set out by DECC. Outline carbon benefits which the Solution you are trialling delivers and explain why the solution accelerates the realisation of these benefits over and above conventional solutions. These benefits can be explained in a qualitative manner for the purpose of screening

The Low Carbon Transition Plan anticipates a significant move towards the electrification of transport and heating, improved building thermal efficiency and substantially increased penetration of DG. This project looks to accelerate the development of these technologies through: **1)** Collection and analysis of empirical data on the effect that renewable generation and energy efficiency measures have on known distribution network types; **2)** Understanding and prediction of the behaviour of DG to enable its potential impact on networks to be modelled more accurately, thereby speeding up its acceptance onto the network; **3)** Creation of a database of energy flows and voltages across different network templates for use in future research into the impact of low carbon connections.

It is anticipated that the above will enable the generation of proven network models that can be used to reduce the need for network re-build. This in turn will enable new renewable generation to be accepted quicker onto the distribution networks by utilising existing headroom and known usage patterns. It will also advise on the recommended level of distributed sensors required to monitor their impact.

In addition the project will: **1)** Support the Welsh Assembly Government's ambition to create a low carbon zone and encourage other parties to co-operate in its implementation; **2)** Enable npower to maximise the benefits from the CESP and CERT obligations by targeting their investments more effectively; **3)** Provide National Grid with evidence of DG that are connected to DNO systems and to which they are currently "blind" thereby improving their forecasting of both demand and day ahead generation and enabling a reduction in spinning reserve; **4)** Provide acedemic institution with raw data for further research.

Has a direct impact on the operation of the distribution network

Set out the Solution you are trialling and make a clear case as to how the Solution described in Section 1 directly impacts on the operation of your network

It is anticipated that new low carbon technologies will have a significant impact on network loading and voltage compliance / control on HV and LV networks. Understanding their impact on the network by monitoring key points will be critical to enabling the right corrective action to be implemented. The project will provide data through:

-- **Substation installations (metering and data concentrators)**. The substation installations will provide load factor data, load headroom, the potential time flexibility for demand side management loads (heating, EVs), modelled by network "template" type. It will provide measurement data to enable analysis of voltage behaviour through load cycles at BS EN 50160 level, power factor, and harmonic penetration. -- **End of Feeder meters and FIT meters** will provide voltage and generation data respectively. The former is required to determine and exploit voltage headroom whilst the latter provides not only load-offset data, but also provides NG with real-time visibility of embedded running DG, leading to improved generation scheduling forecasting with potential to reduce spinning reserve.

Together, the installations and analysis will deliver knowledge that will reduce the cost for new connections and maintaining power quality, increase the speed of response to requests, and provide impacts on network "templates" types for other DNOs. Load and voltage data will also provide information to target loss reduction through the identification of viable asset replacement and voltage reduction schemes. The backbone measurement and comms links to distribution substations further provides HV section by section loading, enhancing the ability to deploy real time rating and identification of those sections where climate change rating reductions require intervention.

Focuses on a network solution which is at the trialling stage and which requires Second Tier funding

Demonstrate why you have not previously used this Solution (including where the Solution involves commercial arrangements) and why LCN funding is required to undertake it. This must include why you would not run the trial as part of your normal course of business and why the Solution is not R&D

Whilst components proposed for this trial have been utilised previously (Technology Readiness Level 7-8), their integration in this manner has not previously been undertaken at scale utilising a common project architecture across multiple network templates and with such a penetration of renewable technologies, or with the same degree of analysis.

WPD has successfully trialled some equivalent technology, monitoring only distribution substations and at small scale, under IFI, and also developed a larger project which was submitted to Ofgem under DPCR5 and to DECC. After consideration, Ofgem advised that the project would not be funded under the requested mechanism but would, however, be a suitable candidate for the LCNF initiative and recommended that WPD submit the proposal to that scheme.

Whilst the project now proposed incorporates aspects of the DPCR5 scheme, it has been enhanced to increase the knowledge which can be shared with other DNOs and acedemic institutions (e.g. Bath and Bristol Universities) – it is template-based to capture different network types rather than being geographically based, it incorporates end to end voltage monitoring, has gearing derived from CERT, CESP and WAG initiatives, addresses DG visibility issues for NGC and utilises skills from collaboration partners.

If approved, the project will also provide a platform for other trials involving multiple and geographically dispersed EV charging, and for wide-area voltage control – please see additional information.

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

Demonstrate that the Solution you are trialling has the potential to deliver net carbon and financial benefits to existing and /or future GB energy customers

The project will establish the basis for developing a standard network configuration that can deliver long-term customer benefits. Those benefits will manifest through:

1) More effective, quicker and repeatable decision making for new DG and EV charging infrastructure network connections, reducing carbon emissions and connection costs;

2) Lower system losses, higher network utilisation and efficiency from a greater understanding of network characteristics (load headroom and DSM capabilities)

3) Reduced levels of spinning reserve from effective integration of small-scale renewable energy generation;

4) Improved power factor management and easier accommodation of EVs, heat pumps and other devices to generate electricity from renewable low-carbon sources;

5) Development of standard repeatable best practices to improve energy delivery, quality and reliability achieved through greater understanding of the impact of low-carbon technologies on power flows and voltages, including more effective network management and control systems, new products and services tailored to meet the needs of customers today and into the future;

6) Potential cost reduction on subsequent installations at substations and downstream voltage monitoring through the development of standard solutions enabling volume production engineering and enhanced knowledge on required density of downstream sensors;

7) Inform configuration of smart meterign voltage alarms;

8) Improved knowledge against BS EN 50160 power quality standards driving improved supply quality, and whether non-complaint vs compliant situations show fit against templates;

9) Reductions in spinning reserve / enhanced national security of supply.

Creates new knowledge that can be shared amongst DNOs
Explain the learning which you expect the Solution you are trialling to deliver. Describe the methodology you will use to capture the learning from the trial
The output from the project will be: **1)** Models identifying the characteristics of each network template and whether the network can be categorised in such a fashion; **2)** A set of models detailing the impact (demand and voltage patterns and headroom) of renewable technologies and EVs on network templates (e.g. town/city, semi-urban, rural) which can be used by other DNOs to model the impact of the new technology on areas of their own networks; **3)** Details of embedded generation load on network areas for use by NG to improve forecasting and generation scheduling; **4)** Raw data for network and embedded generation load to enable other parties to utilise real data in their network scenario models. The methodology underpinning the solution is to deploy sensors onto key points of the network (substations, end of feeders, points of DG) and record the energy flows and network characteristics. Additional sensors will then be added at each point of new generation as it is deployed. The sensors will initially record the network in its current steady state, before starting to record the changes in network performance as additional low-carbon connections are added.

Does the project conform to the default IPR arrangements set out in the LCN Fund Governance Document? (Y/N)	
If no, then please describe the IPR arrangements and demonstrate how the learning from the Project can be disseminated to other DNOs taking into account any potential constraints or costs caused or resulting from, the proposed IPR arrangements	
Yes.	

Section 3: Additional information

Please use the following section to add any further detail you feel may support your submission
Associated projects: **1)** Tier 1 – WPD/NG/DECC funded SCADA interconnection to provide real time distributed generation running output as currently captured by WPD Enmac system; **2)** Future – EV charging infrastructure work (Plugged in Places Bid currenly submitted) – potential partners WAG, Nissan / Renault, Cardiff University, RWE npower, SSE (Supply); Future – wide area (primary substations) active voltage control monitoring software, static var compensation hardware – Hitachi. For detailed information on Welsh Assembly Government Arbed project Google "Arbed strategic energy performance investment" for route to home page For Aberdare I First Low Carbon Town investment: http://www.sustainablebuild.co.uk/uks-first-low-carbon-town.html

Section 4: External Collaborators

External Collaborators' details
Please use the space below to provide the name and business type of any External Collaborators who have contributed funds and /or resources to a Project, or describe the type of External Collaborators you may be seeking to attract
The key project collaborators are: • Accenture, Management Consultancy, providing project management and consulting expertise (£40k contribution to date in resource) • Bath University, providing analysis and research skills • Bristol University, providing analysis and research skills (£500k EPSRC bid) • GE, Product vendor and services company, providing concentrators linked with PPC and other meter communications, as well as ENMAC and software enhancements (provider / knowledge) • National Grid, TSO, modelling and analysis of embedded generation to evaluate impact on load forecasting and generation scheduling (Linkage to Tier 1 NG/WPD. DECC funded project) • npower, Energy Supplier and Services Company - contributing CESP and CERT activity to drive low carbon connections and energy efficiency installations. (£2.4m CESP npower/ Local Authorities) • Power Plus Communications, Broadband Powerline Carrier Product Vendor, Powerline communication technology (provider / knowledge) • Welsh Assembly Government and local authorities - providing investment focus and environment through the £350m (all Wales) Arbed initiative which includes specific targeting in the Western / Heads of the Valleys region of Wales

Section 5: DNO details

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