Low Carbon Networks Fund
Screening Submission Pro-forma

Notes on completion
Before completing this form, please refer to the LCN Fund Governance Document. Please use Verdana font size 10 in your submission, 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 9 pages in total. **Ofgem will publish all the information contained within the Screening submission.**

DNO Group
Western Power Distribution
Participant DNOs
Western Power Distribution
DNO area
South West

Project title
B.R.I.S.T.O.L. for demand response
Project summary
The 'Buildings, Renewables and Integrated Storage, with Tariffs to Overcome network Limitations (B.R.I.S.T.O.L.) for demand response' project will implement demand response (DR) measures to enable the distribution network to respond to low carbon stresses. This DR will allow the deferral of reinforcement and the integration of renewable generation. It will also give the customer more flexibility to manage their demand, and may provide other benefits, such as increased resilience and efficiency. This project will integrate an energy and demand management system, with battery storage and DC networks, to supply Information and Computing Technology (ICT) equipment and DC lighting, as well as using smart appliances and smart tariffs. This technology will be implemented in offices, schools and social housing stock, all owned by Bristol City Council (BCC). BCC already has a guaranteed £1m of funding to install photo-voltaic (PV) generation on a number of schools in Bristol. This project will seek to install a DC system within ten of these schools to supply modified ICT equipment. The schools' PV will be fully integrated into this DC system, along with DC lighting. Demand response in thirty houses will be enabled through the installation of a DC network and battery system, to supply ICT equipment and lighting, and will also include the installation of smart appliances and a home hub to control them. BCC owns their own social housing stock and will achieve consent from their tenants. This project will also include the installation of a DC network into a BCC office environment, with a high density of ICT equipment. Energy and demand management will enable the deployment of these technologies.
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	£2.48m	**LCN funding requested**	£2.23m

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Problem

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

The problem, as identified in 'The UK Low Carbon Transition Plan", published by DECC, is the need to reduce carbon emissions to minimise global temperature rise. This will include the roll out of various low carbon technologies, including micro generation, electric heating and electric vehicles. These technologies will increase the stress on the distribution network including thermal overloads (from heating and transport) and over voltages (from intermittent renewable generation). Both stresses will lead to significant distribution network reinforcement. These short to medium term future stresses will add to the existing distribution network loading, with the inherent inflexibility and inefficiencies in existing equipment.

For example, photo voltaic (PV) generation is unpredictable, and is at its peak when demand is relatively low. To assist with managing system voltage, it would be beneficial to use more demand at these times, or to store the energy for use at a higher demand time. In addition, to reduce peak loading it would be helpful to shift non-time-critical loads towards times of low demand.

ICT equipment, with high usage in schools and offices, is a large and growing user of energy. Most ICT equipment uses direct current (DC), derived through an AC/DC converter, which loses efficiency through switching losses and heating, and produces harmonics and worsens power factor. Losses can be reduced, harmonics/p.f. improved and demand controlled by integrating ICT with DC-networks and battery storage.

To avoid distribution network reinforcement and to integrate larger volumes of generation in a safe and compliant way, it will be necessary to control these variables (demand and generation) and to improve the efficiency of equipment. Demand response will play a crucial role in allowing a lower cost development of the distribution network. However, at present there are very limited methods of controlling demand, except through fixed tariffs like Economy 7 for night storage heating. There is therefore no scope under present arrangements to utilise demand to reduce peak loading and accommodate a rapid take-up of generation. A novel use of proven technology, energy saving options and a development of tariffs will be necessary to implement demand side management, and this project seeks to trial methods to overcome these problems.

Method(s)

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

The method of this project is demand side management, using DC networks integrated with battery storage as a tool controlled by an energy and demand management system. The DC network will be used to supply ICT equipment, specially modified for the task, as well as DC lighting. In addition, there will be smart appliances deployed which will be controlled through a home hub. The project will deploy market ready technologies which are safe, robust and designed for the different project environments.

This technology will be deployed in schools, domestic properties and offices. There will be ten schools in Bristol used in this trial, each school having a PV installation funded by a £1m Bristol City Council (BCC) scheme. Thirty domestic properties will be sourced from social housing stock in Bristol, all of which is owned by BCC. BCC has €1.5m funding through the European Commission called 3ehouses, to install energy reduction measures in 150 properties. BCC plans to install 300 PVs on houses, committing £2m.

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Method(s) continued

There will be a trial in a BCC office, along with a feasibility study undertaken to assess the challenges and benefits of a DC network in a large BCC office / data centre.

The DC networks and battery storage will be combined with the PV where possible, to make an assessment of how PV can be integrated into such a system. The PV will be able to provide much of the energy required for the ICT and DC lighting, with the remainder coming from the distribution network

These demand response technologies will be integrated using energy management tools, which will provide tariff/commercial linkages and deliver benefits to the distribution network. Smart tariffs will be introduced to look at the interactions of demand side management between the customer, the supplier and the distribution network. The combination of these approaches will allow an assessment to be made of whether a demand response market is viable and the level of interactions required to deliver the anticipated benefits.

Sensors will be deployed where required (both on the distribution network and in premises) to monitor, measure and facilitate the integration of the demand response into the distribution network.

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 estimated cost of the project is £2.48m. The funding estimate uses experience gained by the University of Bath in their DC network project and by Siemens in their demand management systems. The project cost will cover the following items:

- DC network installations in ten schools
- DC network and smart appliance installations in 30 houses
- Outreach programme to engage the schools and social housing tenants
- DC network installation in a small office
- A feasibility study for a DC network in a large office / data centre
- ICT infrastructure in schools and houses
- Academic work
- Energy and demand management and aggregation systems
- Development of inter-related tariff structures
- Project management

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 novel arrangement or application of existing Distribution System equipment (including control and communications systems software)	
A novel operational practice directly related to the operation of the Distribution System	★
A novel commercial arrangement	★

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Accelerates the development of a low carbon energy sector

The DNO must demonstrate that the Solution makes a contribution to the Low Carbon Transition Plan.

The domestic / small scale demand response sector is an area that has not yet been covered by previous large-scale trials (as identified by KEMA's recent work with the ENA), so this project will make a significant contribution to the development of the low carbon sector.

The Solutions offered by the demand response in this project are as follows:

- A reduction in the need for local distribution network reinforcement, both in terms of LV cables and HV/LV transformers, due to a lessening of the effect of PV output. This allows greater PV up-take, due to reduced connection costs
- A reduction in peak demand, due to peak shifting, deferring load-based network reinforcement and reducing whole-sale energy prices
- A reduction in the need for new national, non-renewable flexible generation for reserve and response, since peak demands are reduced, and some reserve/response services can be provided through demand response
- Reduction of ICT power conversion losses, harmonics and heat loss, and an improvement of power factor
- The reduced heat loss from the ICT will reduce the air conditioning demand in summer
- Paves the way for the demand response market, by understanding the optimal use of available technology, and by understanding customers' responses to these measures

Deliver net financial benefits to existing and/or future customers

The DNO must demonstrate that the Method(s) they are trialling has the potential to deliver the Solution at a lower cost than alternative methods.

These methods will provide the following financial benefits:

- The deferral of distribution network reinforcement caused by load growth and/or new generation connections. The typical cost of replacing a distribution substation is £25k (source: Ofgem Final Proposals, cost assessment appendix Table 17).

- A reduction in the need for new carbon-based power generation, as a result of increased renewable generation. For this project, there could be up to 208kW of PV facilitated, which, at a 10% utilisation factor, gives 182.2MWh per year. The cost of generating electricity for a CCGT is 2.5p / kWh (sourced from the Royal Academy of Engineering report from PB Power). The PV would derive an annual saving of £4555/yr.

- A reduction in losses, caused by the PV reducing power flow in the distribution network. Losses currently cost £60/MWh per year (source: Ofgem Final Proposals 146A/09 Appendix 5), with the distribution network contributing 6% of losses. 262.8MWh per year of PV will give a loss saving of £946.

- A DC battery storage system has been proved to save the customer up to 32% of ICT energy costs (source: The University of Bath). Such financial savings will encourage customers to self-fund these projects, benefitting the network without network investment.

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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 v.4 of the Governance Document) on the operation of a DNO's Distribution System.

This project will have a significant and positive impact on the distribution network, even though the technology is being employed beyond the meter.

Firstly, the demand response will allow the DNO to shift the time of the customer's demand, which in turn will reduce after diversity maximum demand (ADMD) on the network.

Secondly, the integration of PV into the DC network and battery storage solution will lessen the effect of PV on the distribution network, in terms of voltage rise and thermal overloads.

Thirdly, smart tariffs and energy saving options will provide more choices and incentives for commercial premises and householders to actively participate in demand control, demand reduction and/or demand shifting.

In this project, the effect of the methods on the peak demand of individual premises (whether homes or schools) will be assessed, as well as cumulative impacts on LV feeders and HV/LV substations.

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).

The learning outcomes of this project are detailed below, and will be captured through various means, such as network monitoring and customer surveys.

- The DC network and storage will be tested in different areas, to look at the following:
  * The practicality of installing such devices, ensuring that the products are safe to use
  * The financial benefits to the customer, in terms of off-peak charging of ICT
  * The sizing of batteries for a given ICT volume and PV output
  * Links to the use of batteries from EVs
  * The best way to adapt the ICT equipment for a DC input
  * The effect on the peak demand of each premise
- The smart appliances will be installed in homes, to look at the following:
  * The response of customers to such devices
  * The integration of such devices with a home hub
  * The effect on the peak demand of the premises
- The integration of all methods through a management tool, will look at the following:
  * The best use of each type of demand response in terms of network performance
  * The best way to integrate varied systems into an overall management scheme
  * Whether demand response can be developed into a demand response market

knowledge will be shared through various routes, including academic papers and through the EPSRC-funded HubNet project.

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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.

Focus on Methods that are at the trialling stage

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.

This project focuses on technology that sits beyond the customer's meter, and as such is off-network and falls outside the normal jurisdiction of the DNO. The LCNF Tier 2 funding mechanism allows trials that utilise technology in customers' premises as well as on direct network technology.

In addition, demand side management is unproven on a large scale at the LV and domestic level. This means that it is not a solution that can currently be employed by a DNO to meet their Licence conditions and engineering standards.

The technology to be used has all been used previously and so is not in the R&D phase, and therefore is not suitable for an IFI project. In addition, all technology used will be robust and market-ready. For example:
- The University of Bath has already completed a small trial of a DC network to supply ICT infrastructure in part of their University premises. The battery storage to be used in the project is a mature technology.
- Siemens' customer hub and network integration equipment uses tested and mature technology in an innovative way. An example project is the Fenix project Southern Scenario for Iberdrola (http://www.fenix-project.org).
- Toshiba's battery technology is well established and tested

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Project Partners and external resourcing/funding

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 confirmed project partners are:

- University of Bath (see www.bath.ac.uk/news/2011/03/21/first-dc-network/ for information on the DC network project), particularly with respect to DC networks
- Bristol City Council, providing links to social housing, schools and offices. They have secured the following funding:
  * £1m funding for PV on schools
  * €1.5m 3ehouses funding from European Commission
  * Another potential funding stream in application phase (the LCNF project is not dependant on this unsecured funding stream, but if successful would broaden the scope of the project)
- Siemens, able to contribute demand response expertise and overall scheme design; they can provide equipment and technology for the demand response, energy management and network interface aspects of the project
- Toshiba, particularly in respect to their cutting-edge battery technology and micro-management systems

We are exploring opportunities for partnership with the following organisations:
- University of Bristol, with academic skills in demand side management and simulation
- npower, with skills in tariff design

The project is fully supported by Regen SW

Derogations or exemptions

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

None anticipated

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Customer impact
The DNO should outline any planned interaction with Customers or Customer's premises as part of the Project, and any other direct customer impact (such as amended contractual or charging arrangements, or supply interruptions).
- This project includes domestic demand response, which will require consent from customers to install a package of measures within the house. There will be 30 houses targeted for this project. All domestic properties associated with this project will be social housing stock owned by Bristol City Council (BCC). It will be BCC's responsibility (potentially through a third party provider) to grant the necessary consents for the work, and to achieve all consent required from their tenants. - Consent from the schools will be required. This will be facilitated through BCC. - Consent from BCC will be required for work on the Council's office. - There will need to be a change to customers' tariffs when the customers take part in the demand response programme. The energy supplier will be responsible for introducing and managing these tariffs.

Please use the following section to add any further detail you feel may support your submission.
For clarification, the DC networks will be integrated into the AC networks in each premise, via an AC/DC converter. The DC networks will not be islanded from the distribution network.

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