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 cannot 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
Demand side management of electric storage heating
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*
In the transition to a low carbon economy, it is anticipated that the increasing usage of renewable generation will result in a significant uptake of electric heating and electric vehicles. This could come at a significant cost to networks if this growth is not managed, and may not deliver a sustainable solution if the demand is not driven by generation availability; opposed to the historic perspective of generation being driven by demand. Low carbon generation requires flexible demand because it is intermittent (i.e. wind) or inflexible (i.e. nuclear). Electric storage heating offers an important part of the solution to this challenge, since it has the ability to act as a form of energy storage and demand response which can be operated at the times when energy is available. To take advantage of this however, it requires that any local distribution network constraints, such as excessive loading, can be managed simultaneously. This project aims to meet all of these challenges; active demand management, energy storage and optimising the usage of electric storage heating. Using the existing electric storage heating infrastructure which is currently operated by the radio teleswitch system, a trial of 1000 customers is proposed to develop a novel dynamic load management capability. This will involve two-way communication with an in-home device, capable of being remotely operated, to manage storage heating systems in a trial area within Greater Glasgow. Glasgow is ideal due to its high density pockets of electric storage heating. SPEN (ScottishPower EnergyNetworks) will have control of each customer's heating system to test several optimisation methods, and to gain an understanding of the impacts on the network and customer energy consumption patterns. This will allow for network assets to be optimised in the short term, and the scheduling of electricity demand to match renewable generation in the longer term. This trial will be undertaken within the existing electricity tariff agreements with customers. This will also act as the basis for trialling how future electric vehicle charging can be managed in a similar manner.
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	£3.40m	LCN funding requested	£3.0m

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

Project costs are an estimate at present and have been developed in conjunction with various collaborators and potential suppliers. In preparation for the full submission, these costs will be developed in greater detail and accuracy. Anticipated project phases are:

Phase 1, Months 1-12 (Costs ~£2.4m)
- Engage with customers
- Installation of 1000 in-home devices capable of two way communication
- Development and installation of control system
- Establish two way communication with in-home devices
- Operate system in parallel with existing radio teleswitch to prove functionality

Phase2, Months 12-24(Costs ~£0.7m)
- Development of control system to improve scheduling using data acquired in phase 1
- Implement improved control and configure system
- 6 month period of analysing impact and refine the control system
- Continued customer engagement for feedback on the impact

Phase 3, Months 24-30(Costs ~£0.3m)
- Analysis of the potential for demand management beyond storage heating (i.e. EVs and other discretional loads).
- If necessary, the removal of in-home devices and replacement with previous radio teleswitches.

Project solution

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

This solution will address the challenges of balancing loads on the network when demand management is possible in advance of the future challenges of widespread electric heating and electric vehicles, combined with less predictable generation. It will also look at how demand management can be combined with energy storage for domestic heating.

This project will be undertaken within the Greater Glasgow area where dense pockets of electric heating currently exist. The project will be undertaken in partnership with energy retailers, housing associations and local authorities to identify the precise location for the trial. Customer engagement will be maintained throughout the trial period to ensure that the customer is fully aware of the benefits and is in no way adversely impacted by this project.

The proposed solution will involve installing a device in the customer's premises, capable of two-way communication, remote switching operations and measuring power quality. This will replace the existing radio teleswitch and add additional functionality. The device will be installed on a separate circuit in the premise which is solely for electric heating, as per the existing radio teleswitch configuration. Monitoring of the network loads will be undertaken at the secondary substations within the trial site to understand the impact on the network assets.

Two way communications will be established with these devices and control will be exercised through a separate control system in SPEN's Network Management Centre. This will enable the heating load to be managed in a more proactive manner than the radio teleswitch system and allow for optimisation of load through better scheduling. Feedback from the devices will inform the control system of the impact on the customer, monitor power quality and monitor consumption of the heating systems. This data will be used to further improve the operation of the system and create knowledge which will be shared with the wider industry on the impact of demand side management for electric heating, and the use of storage heating as a means of energy storage rather than just a source of heating. This is a scalable solution and could be deployed nationally as a timely and better replacement for radio teleswitch.

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

At present, heating homes and water contributes to 13% of the UK's total greenhouse gas emissions. The ENSG has identified that the localised electrification of heating is a key short term step for the transition to a low carbon energy sector. For electic heating to successfully deliver a low carbon solution, heating systems will require to be capable of demand response such that they operate, as much as possible, when renewable generation is available. Similarly, a more responsive demand side management will also be important as electric vehicles become increasingly prevalent to minimise the overall impact on the network and generation assets.

This project will demonstrate active demand side management for a trial group of electric storage heating systems which are currently installed and controlled by radio teleswitch. Historically these were used to provide off peak load to large baseload generation which is generally more efficient but less flexible than smaller generation sets. However the existing radio teleswitch system does not have the granularity and flexibility for the challenges of intermittent generation. Working within the confines of existing tariff agreements for a group of customers, the optimised scheduling of heating loads will demonstrate the potential for demand side management. This application will in future enable both balancing of generation with demand, and the management of local distribution network performance. Initially the project will aim to optimise the loading of network assets at a local level which will help to extend their useful life, and maximise the capacity to accommodate the new types of low carbon sources and loads.

Data acquired from the trial will be analysed to understand the potential for electric heating to be derived predominantly from renewable energy sources, and to identify future design improvements. The impact of having an energy storage capability will also be analysed to understand the capabilities which it can offer in meeting both the needs of network operators and energy traders.

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

This project will enable network operators to better understand the potential of demand management and the impact on network assets. Individual control of each customer's heating system will be achieved by installing remotely operated switches with power quality monitoring. This will be connected to a separate circuit within the home which is specifically for storage heating. This device will be capable of two way communication and provide SPEN with real time information on the power quality in the home of these customers to ensure that Electricity Safety, Quality and Continuity Regulations are being fulfilled. Metering within the local secondary substations will allow for the loading of network assets to be monitored to ensure that they are not being placed under excessive cyclic loading which will in turn optimise their usage and potentially extend their lifespan.

The real-time data will feed into a control system, running in parallel with SPEN's network management system, so that an automated solution to load management can be developed. The management system will have a set operating criterion to ensure that customers receive the required level of service while managing the network effectively.

SPEN believe that having real time control of the load for 1000 individual customers is an untried concept in the UK and the potential to manage the loading on network assets can provide long term benefits. This equates to the management of approximately 7MW of load and storage capability; using a solution that is more economic than conventional stand alone storage most of the infrastructure already exists. This solution will enable the improved design of future networks which need to be capable of dealing with electric vehicle penetration, distributed energy storage as well as electric heating.

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

Large scale control of electric heating load, through the radio teleswitch system, is currently utilised in the UK for demand management to accommodate low cost base load generation. This arrangement is a one-way control system, without feedback, and offers only a minimal level of control (load is dispatchable on approximately 50MW increments within SPEN's operating areas). As such, it is just sufficient to switch loads on a broad basis to adjust system-wide demand; it is not at all capable of being used to manage local distribution networks dynamically.

This trial will allow for demand side control at an individual customer level. Historically this has not been considered essential, however the changing generation and load profile will require greater demand control and flexibility at a local network level. SPEN have identified this project as an opportunity to trial demand side management with energy storage capabilities while optimising power flows on local networks which is previously untested in the UK. The trial consists of a combination of proven components never before used for this purpose to improve the existing system, and also prepare for future challenges.

It is anticipated that the project will create opportunities for energy traders as well as network operators but SPEN believe that it is for the DNOs to facilitate these trials and demonstrate their potential in advance of wider uptake. In addition to network management benefits, this project will also create opportunities for other players in the energy chain. This project lends itself to tier 2 funding because it creates opportunities across the energy chain, but for which the DNO is the key component. Tier 2 funding is also essential since the trial will involve installing equipment beyond the customer's meter and a high level of customer engagement to ensure that the trial has minimal adverse impact on consumers.

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

This project offers a solution which utilises the existing electric storage heating infrastructure, thus accelerating deployment, reducing the overall project cost and disturbance to existing customers. The trial will make better use of the existing heating system by improving functionality and network operator's understanding of the implications on the network of this system. A greater level of control will allow for the loading of network assets to be optimised which inturn will extend their lifespan, thus reducing the investment required longer term to maintain the network. Real time data will be available from the customers' premises on power quality, such that the implications to the safe operation of the network including voltage and harmonics can be managed when of adding or removing load.

As discussed above, the project has the potential to deliver significant carbon benefits through the use of demand response in order to provide electric heating from intermittent renewable generation. Trialling demand management will also provide a good platform to examine the challenges that the electric vehicles may create. In this scenario, it is anticipated that future customers will require EV's to be charged overnight, however the network operator will require a system which allows for this load to be managed; minimising the level of reinforcement which could be required. This should make the transition to electric vehicles simpler for customers as network operators will have a better understanding of the potential implications to the network and be able to manage the costs more effectively. By understanding in advance of need, the benefits that storage and demand side management will play, SPEN expect to minimise the delay faced by customers to connect additional load.

The storage of energy offered by the existing system will also provide customers greater flexibility as they have the capability to control the heating in their home even though the network operator is controlling the electrical charging of the system. This will allow the generation load profile to be better balanced, reducing the need for peaking plant which has historically been more expensive and carbon intensive than traditional generation. It will also make way for future in home control which will require management of appliances within the limits of the available generation.

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 knowledge generated from this project will improve the understanding of managing electric storage heating and the implications of demand management at a local network level. To date, demand management has been passive and relatively predictable, but making it more dynamic will require a closer relationship with the customer to ensure it meets their requirements as well as the wider electrical system. The level of incremental control being trialled in this project and the impact on the customer could generate new knowledge which may impact the role of smart meters if they have the capability for demand management. Working with academia, SPEN will utilise the information gathered to help optimise future demand management and share this learning across the wider community. This knowledge may impact not only the design and operation of local networks, but also global generation behaviour and the way that generation and supply are coordinated. Data integrity will be enhanced through automated collection, time-stamping, and logging of real-time readings, to enable post-trial analysis where appropriate. Data will be managed in accordance with data protection provisions. It is intended to undertake further analysis using meteorological information and generation data to look at linkages with customer behaviour and the potential implications of having demand side management which is predominantly driven by the availability of intermittent renewable generation.

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	
Full IP arrangements have not yet been finalised with the project partners, however it is expected that these may generate foreground IPR. If this is the case SPEN will ensure that IPR arrangements comply with Ofgem's LCNF IPR principals or will identify where these are different.	

Section 3: Additional information

Please use the following section to add any further detail you feel may support your submission
This project has implications across the energy chain from generators and energy traders to energy retailers and customers. SPEN will be working with parties across this spectrum to understand the implications and deliver the best solution. The project will also be looking to work with Local Authorities and Housing Associations wherever possible as part of the customer engagement, and to coordinate with other programmes of work that are ongoing. One of the key benefits of this project is that the concept is anticipated to be easily scalable and starts with a manageable number of customers to demonstrate the potential of the system. SPEN believe that this trial will test the potential for a large scale enhanced replacement to the existing radio teleswitch system, while also examining some of the challenges which smart metering will introduce from a networks perspective such as the management of significant quantities of network data. It will also act as a timely replacement for the existing radio teleswitch system which is due to be made redundant as part of the transition from analogue to digital radio broadcasting.

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
A number of organisations are collaborating with SPEN on this project: - GE Energy: developing the design of network control infrastructure and in-home devices - ScottishPower EnergyRetail: information on radio teleswitch system and customer arrangements - ScottishPower EnergyWholesale: information on the implications on energy trading and the wider wholesale market of this trial - Strathclyde University: assistance in developing the project proposals and potential opportunities Other collaborators who SPEN will be seeking to attract include: - Other energy suppliers/traders - Housing Associations and Local Authorities - Telecoms provider - Electric storage heating and appliance manufacturers

Section 5: DNO details

Company
Scottish Power Distribution
Contact name
Martin Hill
Contact Address
New Alderston House, Dove Wynd, Strathclyde Business Park, Bellshill, North Lanarkshire, ML4 3FF
E-mail
Martin.hill@scottishpower.com
Direct telephone line
01698 413000
Position
Low Carbon Networks Manager