ELECTRICITY NETWORK INNOVATION COMPETITION 2019

REPORT AND RECOMMENDATIONS

Prepared for

THE GAS & ELECTRICITY MARKETS AUTHORITY

By

THE ELECTRICITY NETWORK INNOVATION COMPETITION EXPERT PANEL

October 2019

1 INTRODUCTION

This report prepared by the Electricity Network Innovation Competition Expert Panel (the Panel) sets out the Panel's recommendations to the Gas and Electricity Markets Authority on the portfolio of projects to be funded in the 2019 NIC funding round.

Panel Membership

Members of the ENIC 2019 Expert Panel are:

- Jo Armstrong (Chair)
- Rebecca Ford
- Maxine Frerk
- Mike Kay
- Jiggy Lloyd

ENIC 2019 proposals

There were four submissions made to the 2019 ENIC which, collectively, bid for £34.07 million of the £70 million available NIC funding. Full details of each submission will be available on the Ofgem website.

The names of the Funding Licensee, titles of the submissions, the total project costs and the amount requested from the NIC Fund are as follows:

Project	Licensee	Project Cost (£m)	NIC Request (£m)
Constellation	Power Networks (LPN)	9.41	7.53
DC Share	London Western Power Distribution East Midlands (WPD)	5.63	4.72
FreeVE	Western Power Distribution South Wales(WPD)	15.09	12.12
Resilience as a Service (RaaS)	Scottish Hydro Electric Power Distribution (SHEPD)	10.93	9.70

Evaluation methodology

The Expert Panel followed the evaluation process set out in the Electricity Network Innovation Competition Governance Document (v3 2017). Initial submissions were received by Ofgem and were screened by Ofgem staff for compliance with the requirements set out for the Initial Screening Process. Consultants (Aecom) were appointed by Ofgem to assist in the review process. The Panel and the Consultants met the Funding Licensees early in the evaluation process to allow the project teams to present their submissions. The Panel met the Funding Licensees a second time to allow them to clarify points and address matters of concern to the Panel. Throughout the process the Consultants and the Panel sent each of the Funding Licensees a number of questions with the purpose of clarifying the submissions and highlighting areas of concern.

Following these meetings, the Panel met to review each of the submissions in the context of the criteria set out in the Governance Document. In evaluating the submissions, the Panel took into account all of the documents that had been made available: the submissions, their appendices, the Consultants' advice as well as any additional information that had been submitted via Ofgem or the Consultants from the Funding Licensees; they also took account of information from meetings that were held with the Funding Licensees and any material provided during those meetings. Finally, the Panel reviewed resubmitted bids that updated the original; by providing points of clarifications raised at the bilateral sessions as well as corrected any factual errors (note: no material changes to the proposals can be included in these resubmissions). Based on this evaluation, the Panel reviewed the projects against the criteria. This report sets out the Panel's recommendations to the Authority.

The evaluation criteria used by the Panel to review each submission are as follows (see the full governance document for details):

- Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers
- Provides value for money to electricity customers
- Generates knowledge that can be shared amongst all relevant Network Licensees
- Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited development and/or demonstration project to demonstrate its effectiveness
- Involvement of other project partners and external funding

- Relevance and timing
- Demonstration of a robust methodology and that the Project is ready to implement

This report should be read together with the Funding Licensees' submissions and the other information that is published concurrently with these on the Ofgem website. This report sets out the results of the Panel's deliberations and its recommendations for the Authority. As such it is primarily concerned with the views of the Panel; all the details of the projects are contained in the other published documents.

2 EVALUATION OF SUBMISSIONS

The following section provides the Panel's assessment of the factors that underpinned its recommendations.

2.1 CONSTELLATION

Licensee	London Power Networks (LPN)
Total Project Cost	£9.41m
NIC Requested	£7.53m

The proposal

Project Constellation aims to cost-effectively increase the amount of low carbon energy delivered to GB electricity consumers by deferring primary system reinforcement, reducing the need for curtailment and by increasing the available headroom for connection of Low Carbon Technologies (LCTs) and Distributed Energy Resources (DERs). It proposes smart peer-to-peer control functionality in substations to address perceived limitations in the presently deployed central control architecture.

The project would deploy system hardware and communications infrastructure. Part of the initial deployment would include "Core Applications" that would address the Use Cases. The Core Application functionality that would be tested includes:

- Perform load flow, contingency analysis and protection grading assessment
- Execute Adaptive Protection functionality in response to system changes
- Converge solution and execute commands in subseconds.

During the Second Bilateral meeting Constellation indicated that they would also implement methods for all five Use Cases as part of the Core Application. In addition to the adaptive protection these are fault level management, distributed voltage stability control, reverse powerflow management and operability and system resilience enactment.

The communications would be implemented using the Open Field Message Bus (OpenFMB). On the GB system this has already been done using IEC 61850 GOOSE messaging and the IEC 61850 process bus, but these are seen as overly costly for distribution applications. Therefore, the project proposes using the OpenFMB interoperability framework which was ratified in 2016 by the North American Energy Standards Board.

Constellation would also engage third parties to create apps using the data being gathered by the new system. This would be done through an "Open Innovation Competition" public call that would focus on offerings with substantial background IP. New ideas would also be allowed but only in the context of a clear understanding of the IP ownership.

Panel's Assessment of the criteria

(a) <u>Financial, Carbon and Capacity Benefits</u>

Financial benefits

The financial benefits arise from lower deployment costs over that of a smart counterfactual (ie, after deploying traditional reinforcement solutions alongside known smart solutions such as fault current limiting approaches). One fixed deployment set applied to 11xGrid/Primary & 600xsecondary substations produced an assumed net cost saving of £4.5 million. To cover the cost of the proposed NIC allocation (ie, to reach a breakeven position) would require 2 such fixed deployment sets. This would amount to less than 5% of the GB Grid/Primary substations.

Carbon and Capacity Benefits

Constellation is expected to release capacity amounting to 1% and 1.5% of existing capacity at primary and secondary substations respectively. These forecasts are based on experience in the USA, which are then applied to the GB situation, and are considered by UKPN to be conservative.

If, as proposed, there are in the order of 50,000 deployments, the capacity release would amount to 1300 MVA.

This capacity may be taken up by low-carbon generators or by electric vehicles (EVs). The applicants have acknowledged, and the Panel concurs, that there is no certainty as to the proportion to be taken up by each; the Panel is also of the view that there may be marked geographical differences in the ways in which released capacity is used and in the extent to which it reduces constraints on existing generators rather than enable new connections.

If all the capacity released as a result of a GB rollout of 50,000 were taken up by solar and wind generation, the carbon saving by 2050 is estimated to be 175 kt CO_2e. The Panel is satisfied that this estimate incorporates reasonable underlying assumptions (eg, load factors and the speed of decarbonisation of the grid) but actual savings would depend on the number and location of deployments.

Additional and very minor environmental benefits may accrue as a result of the reduced maintenance and inspection activity that was mentioned, but without elaboration, by the applicants.

(b) Value for Money

The idea for Constellation was generated from a joint research project between the partners. £2.2m of project funding would go to Cisco (a leading global IT company). This was not subject to competitive tender, but a 25% contribution is proposed. While the resource requirements have been built bottom-up, there is no evidence of the proposed day rates having been benchmarked. That said, day rates are presented for different activities by the various project partners reflecting the nature of the tasks involved.

Competitive procurement would be used for elements of the project in particular for the core application and the Open Innovation Competition.

The breakdown of the project into three parts creates natural stage gates for project progression.

(c) Generates new knowledge

The panel believes that Constellation could be a route to significant valuable new knowledge in relation to how the control of distribution systems needs to evolve to cope with a transformed energy system with significant intelligence embedded both locally in the distribution system itself, as well as in (potentially) millions of smart and/or active devices installed in customers' premises. The panel recognizes the possible limitations of the development of traditional distribution network control systems using large scale, centralized, sophisticated computing facilities which rely on reliable and resilient communications to all parts of the network that need to be monitored and controlled. Constellation is a counter concept, somewhat less reliant on resilient communications, and where the processing power is distributed. Such an approach would seem to have some inherent advantages over the current centralized model in that it is far less susceptible to a single point of failure, or to the failure of communications.

The hardware to implement Constellation seems to readily exist, but there would doubtless be valuable learning in deploying it for the first time in a GB DNO. However, there is potentially very significant learning from two other areas: the implementation of what UKPN refer to as the core applications, and the development of new applications to run on the Constellation architecture by third party developers.

Some of UKPN's core applications are indeed essential to the smart local control of networks: the implementation of load flow and contingency assessment would be a key feature of understanding and controlling distribution systems that contain lots of embedded sources of energy (ie, generation and storage) and demand comprised of smart devices. The ability to implement these, such that real time autonomous (although co-ordinated) control and reconfiguration of networks based on local events and conditions is likely to be of very high value.

(d) Is Innovative

There are three areas of innovation in the proposal: the hardware deployment in a GB DNO context, the implementation of the core applications in this new architecture and the collaborative development of new applications via third party calls.

The Panel believes the learning from the first of these, the hardware deployment would be modest. However, the other two areas do potentially provide significant advances in distribution system operation.

Unfortunately, the Panel were disappointed in the clarity of the submission in relation to the core applications. The Panel now believes that the focus in the original submission on adaptive protection was confusing and did not help the Panel in its initial understanding of the real scope of the innovation. Through discussion at the bilateral meetings, particularly the second bilateral meeting, it became clear that the core functions are really the ability to run load flows and contingency analysis in real time, or close to real time.

The Panel believes that these core functions are a key building block in delivering the opportunities and benefits that the distributed architecture presents. However, the Panel also believes that there is significant innovation risk in moving from concept to a practical working implementation of appropriate scope. As such the Panel believes it would have been more appropriate for the project (or maybe a differently specified and funded project) to deliver just the core functionality, eg, successful real time load flows and contingency analysis over distributed architecture, before trying to build specific new use cases such as fault level management.

The Panel notes that adaptive protection, which was presented in the original submission as the primary use case, is itself not particularly innovative once the core applications are in place. The Panel also noted that the Constellation submission and bilateral meetings did not make any reference to Electricity North West's Respond fault level management NIC project.

In their revised submission, following the meetings, UKPN introduced five new use cases. In the Panel's view this significantly changed the nature of the proposal making it extremely difficult to understand the full nature of the innovation.

The Panel were unable to understand the theoretical benefits in the maintenance and inspection savings use case that were claimed by UKPN.

(e) Involvement of other Partners and external funding

This proposal was the result of a collaborative exercise that included UK Power Networks (UKPN), the University of Strathclyde (via the PNDC) and Cisco. Western Power Distribution (WPD) are also a member of the consortium providing insights gained from previous experience in architecture development relevant to local substations for LV networks and success in delivering previous NIA/NIC projects.

Each partner is making a financial contribution of at least 10% of their project cost. Overall, there is an 18% contribution to the overall project cost being made by all the 4 partners in the proposal.

The Panel was pleased to see the formal involvement of more than one DNO as this gives greater comfort around the likelihood of roll out of the learning to BAU. However, it would have been more reassured if the intellectual learnings from previous WPD NIC submitted projects (such as Revise) had help define the core of Constellation's proposal. Finally, the Panel would have expected to see a formal academic partner to help with the specification and implementation of, and to ensure the necessary testing of, the core functions within the project.

(f) Relevance and Timing

Given the rapid growth in distribution control system capability already underway, but seemingly all based on centralized systems, it is very timely to investigate other relevant architectures. There has been a theoretical debate for some time about the pros and cons of centralized versus distributed control systems. As far as the Panel knows Constellation would be the first practical implementation of a distributed control system in a distribution system, opening up the opportunity for more effective and efficient distribution network control, and could be a key reference installation for understanding the merits of the debate.

(g) Robustness of Methodology and ready to implement

The Panel is not convinced that UKPN have formulated their plans for Constellation with a realistic assessment of the work content and risks in establishing the core applications. In particular, the Panel believes that UKPN has underestimated the design and implementation challenge of implementing load flow and contingency analysis in a distributed control system, particularly taking into account the data (and data cleansing) needs. Furthermore, it was not clear that the practical challenges associated with the use cases introduced in the resubmission had been adequately thought through.

It appears to the Panel that what Constellation needs to deliver to be successful has only become clear to UKPN as it has engaged in the challenge and Q&A process with the Panel (eg, the success criterion of an operational load flow only emerged for the first time during the 2nd bilateral).

Conclusion

Whilst the Panel accepts this project meets many of the NIC criteria and explores a potentially important technical development in terms of distributed control, it is not convinced that the robustness of the methodology and the proposed plan to implement are currently adequate. Far greater clarity on the core functionality and how that supports the potential use cases would be essential which would then make a funding case more compelling.

Consequently, the Panel is not recommending it to be funded by the Authority.

2.2 DC SHARE

Licensee	London Western Power Distribution East Midlands (WPD)
Total Project Cost	£5.63m
NIC Requested	£4.72m

The proposal

Project DC Share aims to address network capacity issues which may constrain the installation of rapid charging points for electric vehicles (EV) at convenient locations for customers. The lack of convenient charging locations is seen as an impediment to greater adoption of electric vehicles. Network capacity for rapid chargers can be provided through reinforcement, but the project sees an opportunity to consolidate smaller amounts of spare capacity in the existing network using DC equalisation networks connected to substations through fully-controlled power electronic converters. This would allow the spare capacity to be utilised without the risk of overloading the existing network.

The project would also identify the applications where this type of solution is preferred to others such as conventional reinforcement or flexible LVAC networks.

The possibility of connecting distributed energy resources (DER) directly into the equalisation networks is mentioned, but the project doesn't propose to test this functionality. Since existing fast-chargers are AC powered, a new DC powered fast-charger would be developed as part of the project.

Panel's Assessment of the criteria

(a) Financial, Carbon and Capacity Benefits

Financial benefits

The financial benefits arise from lower costs of delivering clusters of rapid chargers located close together in an accessible location for the two main use cases of destination charging and high utilisation urban fleets. The counterfactual has been augmented to reflect the equipment proposed in the FUN – LV solution, ie, it takes into account the evidence from other NIC funded schemes that are assumed to become BAU in the project's timescale. The resultant cost savings between the DC Share proposal and a FUN-LV arrangement is estimated to be around £0.2m per deployment.

Although this cost differential may be viewed as relatively small, the Panel feels DC Share offers an important option for DNOs as they seek to accommodate demand requirements in the fast changing EV environment should the demand for clusters of fast chargers become more prevalent.

Carbon and Capacity Benefits

DC Share would release capacity by optimising the operation of charge points and the DC system; some additional capacity would be released as a result of equalisation. The projected 1,606 deployments are estimated to release 1.8GVA by 2050.

Capacity would be released at a lower carbon cost than the traditional alternative (reinforcement of the AC network). A saving of 26 kt CO_2e by 2050 has been suggested. In comparison with the contemporary alternative that the Panel considers to be more appropriate (FUN-LV) the carbon saving to 2050 may be negligible . However, there should also be carbon savings due to reduced system losses in a set-up which has fewer AC<>DC conversions.

In comparison with FUN-LV, DC Share could offer an additional small environmental benefit because it would require less land take at substations and the installation of less street furniture.

The applicants have also referred to the possibility that each DC Share network could offer opportunities for connection to low carbon generators. The Panel shares their view that this is conceivable but unlikely, given the limited occurrence of suitable generators in the urban areas where DC Share is expected to be deployed.

(b) Value for Money

The project was originated by Ricardo responding to an ENA NIC third party bid. Ricardo's costs account for around a third of the overall project costs and although they have made a contribution of 10% as a reduction on their normal professional rates, this still feels a relatively high cost for what appears to be essentially a project management role. While the resource requirements have been built bottom-up, there is no evidence of the proposed day rates having been benchmarked.

The equipment is being provided by Turbo Power Systems as a project partner rather than being competitively tendered. This increases confidence around deliverability but misses an opportunity to market test the costs of the technology which could be available from a range of providers.

Other elements would be competitively procured.

Notwithstanding these concerns (which stem in part from the desire for third party led projects) the overall project costs (NIC funded) of £4.7m could be recouped quickly with a small number of implementations.

A stage gate is included in relation to identification of a suitable site with limited spend in advance of that stage gate.

(c) Generates new knowledge

Whilst the Panel recognizes that other NIC projects (ie FUN LV and LV engine) have similarities in being able to pool available substation capacity, DC Share does generate new knowledge by using a wholly DC solution. The proposed solution requires adapting and/or redesigning existing AC to DC technology. DC Share also requires the design and provision of DC (as opposed to AC) powered EV charging equipment. The overall control system for the DC components within and between the trial substations is also a new application.

(d) Is Innovative

The concept of using DC infrastructure to share capacity between AC systems is not entirely new, but the Panel recognizes that using it to share capacity between LV substations for the purposes of supplying DC charging infrastructure is an innovative adaptation, with possible efficiencies over existing approaches.

(e) Involvement of other Partners and external funding

The project was proposed by Ricardo Energy & Environment in their response to the ENA NIC Third Party Call. WPD would be the Funding Licensee and Electricity North West would be a formal collaborator on the project. Turbo Power Systems and Vectos are also project partners with Ricardo being the lead partner.

All partners are making a cash contribution of at least 10% of their assumed reimbursement from the NIC funding request.

The Panel welcomes the formal input from another DNO as this supports the potential for more rapid BAU roll-out.

(f) Relevance and Timing

Whilst there is uncertainty over the exact development trajectory of low carbon vehicles, it seems highly likely that there would be a growth of battery electric vehicles for which a very significant growth in charging points would be required, including those that provide rapid charging so as to match (as far as possible) current experience with refuelling of conventional vehicles. The Panel expects that a variety of solutions would be appropriate if this is the case, and to this end recognizes that DC Share could be a key option amongst them. Given the emerging commitment to Net Zero, and the need for infrastructure to match that commitment, the development of a range of efficient solutions as soon as possible would help ensure the minimum cost growth of the infrastructure.

(g) Robustness of Methodology and ready to implement

The Panel can see that the hardware, as developments/adaptations of existing technology is unlikely to present a significant risk to the project and has no reason to doubt the projects confidence in developing and installing it in the project's timescales.

What is less clear to the Panel is how straightforward it would be to identify suitable sites for the installation of the EV chargers and to secure the necessary legal consents etc for their construction. However, it is satisfied that this would not affect the trial, that policy and practice amongst local authorities and developers is conducive to the identification of more sites in future and that the project partners include Vectos who have specific expertise in this area.

The Panel expects that the project's approach to gaining experience from commercial fleets, although less representative of typical future real world use (because of for example the provision of free charging), would provide some evidence on customer behaviour but is clear that as explained, this is secondary to securing the necessary load to test out fully the capabilities of the technology.

Conclusion

The Panel found the DC Share evidence presented a compelling case and is recommending it to be funded by the Authority.

2.3 FREEVE

Licensee	Western Power Distribution South Wales(WPD)
Total Project Cost	£15.09m
NIC Requested	£12.12m

The proposal

The FreeVE project would recruit 640 part-funded domestic consumer households (320 each in South Wales and the West Midlands) equipped with a combination of (up to) three sets of equipment: Hybrid Heat Pumps, Solar PV and (optionally) a battery EV and a smart charger. These Low Carbon Technologies (LCTs) are to be installed by developers and supplied by others (although it is not sufficiently clear how EVs would be supplied or recruited). At present there are 40 homes already equipped in the West Midlands and 253 in South Wales (5 more for Project MADE). Project funding of £7,000/house has been allowed for adding additional LCTs where no other funding exists.

The project would control the devices in these homes to see if the network can be utilised better. This would be done via control and communication systems installed as part of this project.

The learning would be about:

1. the behaviour of the customers in response to the opportunity to participate in these schemes
2. the creation of specific load profiles for the network that increases understanding of the impact of these types of schemes and allows effective network planning

The houses would be far enough apart to avoid clustering (managing the risk to the operational system) and the actual impact of LCTs on networks (which is largely about clustering) would be simulated by adding each house's data to a virtual network.

Trials would be run over three winters.

PassivSystems would manage the deployment of LCT controllers and develop the software for behind the meter management of the LCTs and demand against constraint price signals.

The Methods would test:

- Method 1: Business as Usual – Asset optimisation only, no in-home coordination. This method trials a scenario where LCTs act autonomously in response to consumer energy price signals.
- Method 2: Grid aware multi-asset coordination with smart controls. The LCTs coordinate their response to consumer energy price signals and take steps to manage the demand on the network. Each home acts as an independent entity, receiving price signals for energy and DSR against which it responds.
- Method 3: Grid and location aware multi-asset coordination with smart controls and aggregated portfolio management. Location specific data is added to Method 2 and centrally managed aggregation included in the control strategy. The Method includes awareness of network constraints and the DSR transactions are managed at portfolio level. The potential for income generation from network services is tested.
- Method 4: Grid and location aware multi-asset coordination with smart controls and peer-to-peer portfolio management. The Method 3 market structure is amended so there is no centralised system. Instead there is a peer-to-peer market/auction process that sets prices locally to optimise the use of embedded generation and storage assets ahead of seeking to offer flexibility services to the local energy network.

While much of the technical learning could be gained from offline simulations (including random ones), there would be some learning regarding behaviour of customers in response to different rewards and the degree of control over their energy flexibility they would be willing to sacrifice.

A risk with the trial is that the customer behaviour is modified through learning from the early part of the project that has an impact on later stages.

Panel's Assessment of the criteria

(a) Financial, Carbon and Capacity Benefits

Financial benefits

The financial benefits estimated to be derived from the deployment of the FreeVE proposal look substantial, having been based on a systems-wide impact assessment. This is not the methodology normally applied to NIC bids where the assessed benefits are based on the potential direct benefit that could accrue to GB electricity network charge payers.

Adopting a systems wide approach to measuring benefits is of value in helping to assess the impact of GB-wide policy options in general. However, such an approach makes it difficult to show how a GB-wide deployment of the Method solution would deliver wider benefits for ALL GB electricity customers. The benefits arising from NIC projects must be based on their projected to deliver enduring benefits to the customer from specific replicable deployments. The Panel requested this evidence, but it was not provided. The Panel remains unclear as to the winners and losers and the potential for uneven distribution of the benefits and costs.

Carbon and Capacity Benefits

Similarly, the systems-wide approach does not provide the Panel with a forecast of the capacity or carbon benefits of implementing the FreeVE project but a measure of the theoretical carbon benefits accruing in a scenario in which the flexible use of LCTs is optimised across the GB network. The Panel acknowledges that the project may provide a measure of the gap between these theoretical carbon benefits and those that are achievable, and that such a measure would be useful, alongside those generated by similar projects, in informing both policy (for instance, pathways to Net Zero) and practice (for instance in encouraging customers to adopt flexible use of LCTs). However, the Panel believes that any such measure would be of uncertain utility given its other reservations concerning the design of the project and would not generate carbon benefits in the manner envisaged in the NIC criteria.

(b) <u>Value for Money</u>

The project was proposed to WPD by PassivSystems following other NIC and NIA projects and the project would be led by them. As such PassivSystems' costs (£4.7m) account for almost 40% of the total NIC funding required. As a third party led project this was not subject to competitive tendering. While the resource requirements have been built bottom-up, there is no evidence of the proposed day rates having been benchmarked to give the Panel assurance of value for money.

Moreover, the Panel remains concerned that the evidence provided did not offer sufficient reassurances that this project would ultimately support a competitive marketplace for flexibility control services (rather than giving advantage to PassivSystems in a competitive part of the market).

Similarly, it is unclear how the contributions of other consultants and academic partners (who were brought forward from the MADE project) were scrutinised to ensure value for money.

The project has sought to leverage other sources of funding for DERs through Welsh government etc. but would still be paying over £4.4m to finance EVs and other DERs. The Panel has strong concerns about customers' money being used to fund, for example, the purchase of EVs benefitting a small number of customers directly.

The MADE NIA project, which is a precursor to this, is still only part way through and would generate a lot of learning. Until that project is complete it is unclear what the gaps in learning are, what the incremental learning is from FreeVE, and whether a more focussed pilot would suffice (or alternatively if it is a larger scale trial that is actually needed).

There is no acknowledgment of the significant uncertainties around how technology and the market would evolve (including the uncertainties set out in Ofgem's recent Insight paper) and hence it is unclear how robust the conclusions of the project would be, in the face of different market evolutions.

(c) Generates new knowledge

The Panel were unable to conclude the extent of any new usable learning given the lack of clarity on how FreeVE builds on the yet to be completed MADE Project.

The aspect of the learnings relevant to the DNO/TNO/SO seem to be around the load profiles, with the expectation that these can be used for future network planning. However, it's not clear that the learnings from the project (regarding the load profiles) is statistically robust to be used in this way. Only 640 homes are involved in the trial, and once these are further segmented (eg, according to socio-demographic data, house type, geography, etc.) there could be as few as 10 homes per customer type being investigated. Although the revised submission states that "there is no existing data on potential sample variability to draw on to base a formal sample size calculation for inferential analyses", there remains solid protocols for establishing sample size based on the hypothesised effect (eg, based on learnings from similar projects such a MADE, Freedom, ESC living lab, or other projects references in Section 10.3.1), minimum expected impact (eg, savings of at least 20% when compared to uncoordinated control, as per page 19 in the revised submission), and desired significance level. However, insufficient evidence has been provided to the panel to substantiate claims "that the sample size selected will provide sufficiently reliable and robust results".

Related to the concerns around the statistical robustness of the data and load profiles, which are a key enduring output of the project, it is also not clear how replicable the solutions would be or how appropriate the data would be for other Network Licensees, given that it is very specific to the two areas (and geographies and climates) being investigated.

(d) <u>Is Innovative</u>

The key innovation is understood to be the learning regarding the load profiles of households with multiple LCTs controlled for participation in energy and flexibility (for energy and networks) markets; customer response to control interventions of their LCTs (eg, if heating control makes their home uncomfortable); and the development of a platform functional specification. However, there are concerns over whether the approach selected would deliver this innovation.

The load profiles may be focussed on a too selective group to produce generalisable learnings. Because the target audience for the trial are homes who already own two LCTs (with this project providing funding for a third), there is concern that the homes selected would not be representative of wider customers.

Understanding customer response to the different control functions in the trial would be key, but the Panel have concerns about how this is being undertaken. Customer response can be very varied depending on the specific context in which their assets are controlled, the frequency with which they notice the control, the degree to which they are involved in setting parameters, and the degree to which they feel like they have perceived control (eg, to opt out). There is not sufficient detail in the FSP to give comfort that the approach taken would yield robust insights.

It remained unclear to the Panel what is meant by the development of the platform functional specification, and whether this would potentially close the market down, or readily facilitate a GB roll out.

Justification for why the Project can only be undertaken with the support of the NIC revolves around how the learning from it would inform specific risks associated with the Project (eg, commercial, technical, operational or regulatory). It is not clear what the commercial or technical risks are in reference to the networks nor how a robust business case for the platform would emerge.

(e) Involvement of other Partners and external funding

There are 14 separate partners included in this proposal making a total contribution of around 19% of the total project cost. However, most of these are in-kind. WPD is providing 10% of the total project costs, with the majority of the other partners making a contribution of 15% of their own project costs. Nissan is contributing 50% of its costs with Northern Powergrid and Scottish & Southern Electricity Networks contributing 100%.

PassivSystems is the lead partner working at the project lead level with licensee WPD and is contributing 15%. Such a wide array of partners can be viewed positively as it increases the likelihood of the wide dissemination of the project results. Nonetheless, it also adds to project risks should any one participant fail to meet its obligations, on time or to the value proposed. This reinforces the need for effective project management which is what PassivSystems is providing following their involvement with the Freedom project and having had experience with implementing and managing similar sub-contract arrangements.

The Panel welcomed additional DNO input as outlined in the proposal. However, evidence of meaningful input during both the design and implementation phases is far from evident, meaning BAU roll out may not be readily achieved.

(f) Relevance and Timing

The aims of the project are of relevance given the growth in LCT use. However, the Panel were firmly of the view that it needed to build on the learning and results of the similar, albeit smaller, MADE project and so this bid was at best premature in seeking NIC funding.

(g) Robustness of Methodology and ready to implement

A key requirement for the success of the project is in the ability of the project team to secure the cooperation of the necessary homes and retain them throughout the various stages of the trial. In addition, the trial requires all 640 homes to be signed up with LCTs installed before winter 2020. Current learning from other projects shows this to be neither easy nor trivial, and the inability to enrol at least 640 homes could post a substantial risk to the project's ability to deliver statistically significant load profiles.

The Panel accepted the contribution from partners who can secure the cooperation of households previously involved in LCT trials as a benefit but also saw it as a challenge if GB BAU roll-out was to be based on the results generated from 'non-typical' households.

The Panel is also unclear as to how robust the results from the sample of 640 homes would be, due to the range of household types and geographies that need to be accounted for when developing the load profiles. The Panel is unsure how reliable this data would be when scaled up to the GB level given the limited number of households in each cluster (ie, of similar household types, geographies etc). At the 2nd bilateral the Panel received mixed messages on this critical point.

Finally, the Panel is also unconvinced as to how useful the analysis on the homogeneity or diversity of the load profiles could be given the low diversity of socio-economic groups and house types involved.

Conclusion

The Panel recognises the importance of flexibility and learning in this area. However, it was not convinced of the robustness of the methodology, the implementation plan or the VFM of this project. In particular, the Panel had concerns that the direct benefits for the networks comprised a small part of the potential benefits of this project and hence whether it was appropriate for NIC funding. On this basis the Panel is not recommending it to be funded by the Authority.

2.4 RESILLIENCE AS A SERVICE (RAAS)

Licensee	Scottish Hydro Electric Power Distribution (SHEPD)
Total Project Cost	£10.93m
NIC Requested	£9.70m

The proposal

Due to the size of the demand in some remote areas, networks that theoretically require more than one circuit to supply demand can only meet their security of supply obligations by deriving a second supply from generation as back-up to a single network connection. This is a problem in remote areas and islands such as the Western Isles and Isles of Scilly where the cost of a second circuit would be prohibitive or impossible to secure the necessary consents.

When these networks lose supply because of the unavailability (ie, fault) of the single circuit, they are required to operate self-sufficiently (in island mode) or have to wait for connection to the main system to be restored. Typical small and embedded generators cannot operate in island mode, principally lacking the systems to balance the demand against the generation. Currently this resilience is generally provided by reciprocating machines (gas and/or diesel) that can manage their output levels against the demand, provide inertia and set the frequency.

This project would test the use of a system called Primary RaaS, allowing low carbon technologies (such as batteries and renewable generation) to provide resilience instead of using (diesel) standby generation. Primary RaaS would connect at 11kV at a 33/11kV substation and would use embedded generation, demand side response (DSR) and a resilience system (the RaaS Central Hub containing a battery energy storage systems - BESS) also connected at 11kV to provide resilience against loss of supply and act as a virtual synchronous machine. A RaaS Controller manages the network when in island mode. The latter appears to be an evolution of the ANM schemes used by SSE.

Following loss of the network connection, a short outage (approximately 10s) is required to allow the battery to switch from being a source of energy (real and reactive power) to being the voltage reference for the network, allowing embedded generation on the network to lock into its signal.

RaaS has been trialled by E.ON in Simris, a village in Sweden. That network operated as a microgrid, permanently disconnected from other networks and the project appears not to have tested market mechanisms. However, a later extension to the project included a DSR scheme.

Panel's Assessment of the criteria

(a) <u>Financial, Carbon and Capacity Benefits</u>

Financial benefits

The financial benefits projected to be delivered by the RaaS project are derived from replacing traditional network investment and diesel-powered generators with innovative network management systems and alternative local renewable generation and local energy storage. The estimated value of this new approach is to deliver an estimated £146 million (NPV) by 2050.

The RaaS proposal estimates there are at least 111 primary substations of the 114 candidate sites that could deploy the RaaS Method. The breakeven level of deployments is projected to be 7, around 6% of the identified primary substations candidates.

Carbon and Capacity Benefits

RaaS would not provide any additional network capacity. It has the potential to reduce the number of occasions when low-carbon generation is curtailed during islanding which would be a desirable but very small benefit.

Carbon savings would arise where RaaS is deployed as an alternative to reinforcing the network or (more likely) DNO use of diesel generation or a DNO-owned battery. Assuming that there are 111 deployments, that landscape sensitivity in the relevant locations would be high, that diesel generation would cease by 2028 and that a DNO-owned battery would perform no other function except stand-by generation, the applicants estimate that this benefit would amount to 16.6ktCO_2e by 2050. This is a modest saving and if, as the Panel expects, actual deployments would be fewer than forecast, the estimate is also on the high side. Nevertheless, the Panel is satisfied that the proposal is consistent with the aims of accelerating the development of a low carbon energy sector and delivering environmental benefits. It also notes the potential indirect benefit of demonstrating another revenue stream for low-carbon generation installations that incorporate energy storage.

The Panel has explored the possibility that DNO use of diesel generation might continue beyond 2028 or that deployment of RaaS might in practice, increase the use of diesel generators (either pre-existing or newly provided in response to the market for RaaS). Both scenarios would reduce the level of carbon benefits. It is satisfied with the applicants' assessment that UK policy developments make it unlikely that this would be an economic proposition, except perhaps in the short-term and/or on a very limited scale.

(b) Value for Money

The project was the result of the result of an ENA Call for Ideas and as a third party led project was not subject to competitive tender. However, SSEN have benchmarked against SSEN's existing framework supplier arrangements to ensure competitive staff day rates.

A stage gate review would be undertaken at the end of phase 1 prior to deployment. This would ensure the project continues to deliver the anticipated benefits before the majority of costs are incurred.

While E.ON are involved as a project partner, through the involvement of Costain, effort is being put into designing contracts that would ultimately be attractive to a wider market and so ensuring E.ON does not benefit unduly from its involvement.

Competitive procurement would be used for elements of the project such as research and analysis and any hardware.

The Panel is of the view that the project represents good value for money considering the costs, project structure and likely incremental learning.

(c) Generates new knowledge

The ability to create and manage islanded parts of distribution networks is not new and has been implemented all over the world. It has not been implemented in GB as a standard approach, and there are several technical issues associated with earthing and protection, for example, that would need to be solved. So, whilst the techniques involved are not new, their development and deployment in GB is a substantial development of the knowledge from other jurisdictions.

The Panel notes that these are essentially complementary issues to those faced in the NGESO "Distributed ReStart" 2018 NIC project and the Panel is pleased that the need to harmonize the learning from these two projects has been recognized by RaaS. The Panel believes there would be benefit in ensuring a formal tie up between these two projects to ensure the whole system learning is maximized.

RaaS would generate new knowledge in the identification, standardization, packaging and commercialization of a service, provided to the DNO by a third party, to restart and manage a power island within a distribution system.

(d) Is Innovative

Whilst accepting that the creation of power islands is not now innovative, the Panel does also note that to date it has not been undertaken as a routine activity from fixed assets in GB and recognizes that some innovation would be needed to overcome the GB challenges.

However, identifying that the restart of a power island can be provided by either an owner of a suitable generation or storage asset, or even an independent third party, as a commercial service rather than one provided by the DNO is novel. Consequently, the scope and content of the resulting contracts is also novel. A key feature of the commercial innovation is to investigate how value from RaaS can be stacked with other value streams to the asset owner, making projects for such assets more likely/viable in the future. Successful implementation of this project should provide a template for its application quite widely across GB.

(e) Involvement of other Partners and external funding

The RaaS project was proposed by Costain and E.ON via the ENA Joint NIC Call for Ideas. As a consequence, both would deliver the project alongside Scottish & Southern Electricity Networks (SSEN). Costain and E.ON have taken the learning from E.ON's SIMRIS project operating in the Swedish market to develop RaaS, an application of this to the GB market. As a consequence, the 3-company partnership provides the necessary assurances to the Panel that the project has the necessary practical know-how of how to test the possible new market underpinning the wider application of the RaaS Method. The Panel noted and was impressed by the obvious complementarity in skills and roles provided by the team shown at the 2nd bilateral.

The required cash contribution of 10% to the project is being made by SSEN, with Costain and E.ON making in-kind contributions in the form of reduced day rates.

(f) Relevance and Timing

The Panel believes that RaaS might have wider applications than those claimed by SSEN in the submission. Certainly, the Panel recognizes the benefits claimed for the use cases in the submission but notes that the RaaS service can potentially be used to offset other system reinforcement challenges, ie, be used for more situations than just fault response. For example, the Panel believes it could be adapted to be used for routine maintenance of 33kV circuits, or to help meet new demand peaks.

The rapid growth of battery technology, and the continued penetration of distributed generation, provides more and more opportunities to create RaaS services both for the application envisaged in the submission as well as the other applications the Panel believe would develop.

(g) Robustness of Methodology and ready to implement

The Panel notes that the successful technical implementation in Sweden and the key contribution that E.ON would make as a partner in transplanting that learning to RaaS.

With regard to the ability of RaaS to find suitable locations the Panel notes the work already undertaken and has no reason to doubt that one of these can be chosen for the successful implementation of the project.

Clearly the appetite of third parties to enter into a RaaS contract is currently unknown, however the combination of E.ON and Costain does bring the ability to reach a wider set of potential participants through their market knowledge. Again, the Panel sees no reason to believe that the identification of one or more participants for the purpose of the trial would be unsuccessful.

Conclusion

The Panel found the RaaS evidence presented a compelling case and is recommending it to be funded by the Authority.

3 RECOMMENDATIONS FOR FUNDING

In summary, based on these evaluations the Panel makes the following funding recommendations to the Authority, subject to the various conditions outlined above:

Recommended for funding

Project	Licensee	NIC Request (£m)
DC Share	London Western Power Distribution East Midlands (WPD)	4.72
Resilience as a Service (RaaS)	Scottish Hydro Electric Power Distribution (SHEPD)	9.70

Unable to recommend funding

Project	Licensee	NIC Request (£m)
Constellation	Power Networks (LPN)	7.53
FreeVE	Western Power Distribution South Wales(WPD)	12.12

4 ISSUES FOR FUTURE COMPETITIONS

Reflecting on this year's projects the Panel would like to highlight a few issues for the companies to consider ahead of any future NIC submission.

Strategic considerations

Net Zero by 2050 requires a transformation in the energy sector. Whilst RIIO2 will pick this up as a central theme, the changes to the NIC arrangements will not be introduced until 2021/2023. The Panel would be pleased if NIC submissions in 2020 and future years could recognise explicitly the challenges of Net Zero and the project's part in addressing them. In so doing the submission should anticipate how successful innovation will be judged in RIIO2. This suggests careful consideration of whether proposed NIC projects are fully open to sector transformation or inadvertently perpetuate historic paradigms that might turn out to be counterproductive.

Third Party Calls and VFM

Whilst the Panel sees the value in third party call arrangements providing meaningful, new sources of innovative ideas and projects, it is essential that the bidding teams provide the evidence that all efforts are being taken to ensure the customer is also getting value for money, ie, the non-DNO partners are subjected to market testing, or other critical assessment, of their product prices and day rates. A headline discount on untested day rates does not on its own provide adequate assurance of value for money.

Involvement of multiple network companies

As innovation on the network develops, joint proposals are highly desirable to increase the certainty that the project deliverables are enduring across the GB network. What remains unclear to the Panel is the extent to which the knowledge and experience gained from previous and on-going innovation projects is being fully integrated into new projects and in project implementation strategies.

5 ACKNOWLEDGEMENTS

As in previous years, the Panel fully recognises the amount of work required to make NIC bids, including the time and effort taken to provide the Panel with answers to all questions posed. Consequently, the Panel would like to thank all the companies for their active engagement both in their written answers and at the bilateral meetings.

The Panel is also particularly grateful to the Ofgem team that provided exceptional support to the Expert Panel. Their technical and administrative input along with the technical support of the Consultants AECOM ensured the Panel was able to undertake full and effective scrutiny of the NIC proposals.