ELECTRICITY NETWORK INNOVATION COMPETITION 2018

REPORT AND RECOMMENDATIONS

Prepared for

THE GAS & ELECTRICITY MARKETS AUTHORITY

By

THE ELECTRICITY NETWORK INNOVATION COMPETITION EXPERT PANEL

October 2018

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 2018 NIC funding round.

Panel Membership

Members of the ENIC 2018 Expert Panel are:

- Jo Armstrong (Chair)
- Alan Bryce
- Maxine Frerk
- Mike Kay
- Jiggy Lloyd

ENIC 2018 proposals

There were four submissions made to the 2018 ENIC which, collectively, bid for £44.392 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)
Black Start from DER	National Grid Electricity Transmission plc	11.69	10.27
Revise	Western Power Distribution (West Midlands) plc	12.571	11.103
Charge	SP Manweb plc	8.545	6.85
Optimise Prime	London Power Networks plc	34.691	16.399

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 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. 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 BLACK START FROM DISTRIBUTED ENERY RESOURCES (DER)

Licensee	National Grid Electricity Transmission
Total Project Cost	£11.69m
NIC Requested	£10.27m

The proposal

Black start is the process that would be required to restore the National Electricity Transmission System if a total shutdown were ever to occur. This has never happened in Great Britain, but there have been cascade failures in other countries that have caused a total shutdown, and in these circumstances it can take days to restore the system fully. Under current black start plans, the Electricity System Operator, National Grid (NG), has contracts in place with a relatively small number of large power stations, which are connected to the Transmission network. These power stations are capable of self-starting without the need of external electricity supplies, and are therefore capable of delivering energy on to the system so that, in turn, other power stations that do require external supplies for their auxiliary systems, can gradually be restarted, and demand restored to rebuild the total system.

The current requirements for providing black start services are:

- to start up (following a Total Shutdown or Partial Shutdown) independently from external supplies,
- to be able to energise the transmission network, and
- to be able to provide block loading of local demand (typically 35-50MW blocks).

As conventional power stations on the transmission system are being increasingly replaced by large renewables and by distributed energy resources (DER) on the distribution networks, it can no longer be taken for granted that existing large conventional power stations will be available to fulfil black start duties, in the normal course of business. Under these conditions they have to be incentivised to remain available for black start, and this has already increased the cost of black start services from under £20m p.a. in 2012/13 to around £60m p.a. in 2017/18.

This project addresses the potential lack of large power stations able to compete to provide black start services in the future, by investigating the use of distributed energy resources (DER). For this to work it will require the participation and coordination of a large number of (smaller) generators, and for "power islands" comprised of DER and blocks of demand to be established in DNOs' networks, expanded and synchronised with one another to re-build the total network. The project will develop and test the organisational arrangements, technical requirements, market mechanisms, and regulatory adjustments necessary to make use of DER as providers of more cost effective black start services in the future.

The project will focus on the following DER: small thermal power stations, small hydro stations, wind farms and small gas or diesel stations. While the project title refers to DER as a class, the project and its trials will be aimed at medium sized synchronous generation and windfarms. This is due to the assessment that other forms of DERs, such as solar, are not yet at sufficient TRL for black start. A separate NIA study is being undertaken to determine the minimum (technical) requirements for DERs to participate in this market.

Potential trial networks have been identified in the SPD and SP Manweb networks. The requirement, impact and feasibility for trials will be determined during the first phase of the project.

The project has the following activities:

- 10 case studies, 47 DER, >1500 MW (subject to review)
- 35 workshops for stakeholder engagement and consultation
- Desktop exercises to test processes & communications
- Power system studies to examine DER and network
- Live trials of Black Start from DER to energise the Transmission network.

and deliverables:

- Organisational
    - Process design
    - Roles and responsibilities
    - Specification for required systems and telecoms
- Technical
    - Performance requirements
    - Test specifications
    - Potential for roll-out

- Procurement and Regulation
    - Options for market structures
    - Barriers in codes, licences and standards
    - Generic standard terms of contract

Panel's Assessment of the criteria

(a) Financial, Carbon and Capacity Benefits

Financial benefits

NG estimate that the financial benefits arising from this black start capability of GB roll out is £115m by 2050 (NPV terms).

This financial benefit is derived from the expectation that deploying DER in the black start mix of generation means the price NG would have to pay for black start services will, as a minimum, not increase in the manner expected from the existing conventional mix of generation. NG estimate that delivering in an uncoordinated manner where collaboration is not developed as per the NIC approach risks the likelihood of inefficiencies which are estimated at c15%.

Carbon and Capacity Benefits

This project is an opportunity to establish if and to what extent, the UK can reduce its reliance on large, fossil-fuel powered generators for the provision of black start services. The Panel considers this to be an important contribution to the UK's ambition to develop a low-carbon electricity supply. NG estimate the potential carbon benefits of a successful GB rollout to be in the order of 0.8mtCO_2e by 2050; this represents the emissions that would otherwise arise because of the need to hold conventional generators in a state of readiness should a black start be required. The Panel considers the project would generate carbon savings (whilst accurately estimating this has been difficult for NG), and these savings would arise regardless of the type of DER (low-carbon or not) that is found capable of taking part.

For existing and future operators of low-carbon DER, a successful demonstration may, at the margin and depending on location, represent a small improvement in their business case. As proposed, this will apply to wind farms but may extend to solar and batteries as noted above. The Panel also believes

that learning from this project may be relevant to the operation of micro-grids which are often, although not exclusively, a prerequisite for viable low-carbon projects.

(b) Value for Money

The Panel believes the project will offer customers value for money.

The project was a TNEI proposal submitted as part of a competitive call undertaken by NG. It was one of 37 proposals, and the selection criteria used was based on its strategic relevance, the costs versus benefits offered, the associated project risks and existing activity being undertaken in NG.

The project partners are all making a 10% contribution to the project costs. The Panel also sought and received confirmation that the proposal would deliver VFM around any future BAU deployment of the solutions developed.

(c) Generates new knowledge

The output from the case studies and physical trials arising from the project will take the potential use of DER for black start services from concept to "business ready". The ESO, owners of DER, and DNOs will gain the necessary understanding of what is required to coordinate a large number of players in the complex process of black start, the technical requirements for DER and DNO "power island" combinations, and the associated market and regulatory enablers.

Of particular importance the project will define the communications and communication systems required to maintain coordination amongst the much larger number of participants compared to traditional black start plans. The work on communications will also identify and, if possible, test the resilience requirements. This will be the first time that the GB transmission network is restored using DER. Owners of DER will benefit from learning how they might be able to bid into a market to offer black start capability to NG.

The Panel is reassured by SPEN's role as a Partner that the project will obtain the necessary input from the DNO, both in delivering and monitoring the technical trial on their system, and in supporting engagement with DER participants.

The Panel were reassured that NG and SPEN gave their commitment to deliver two live trials, with a clear intent to re-energise some transmission circuit using DER.

The learning from the communications requirements being tested are essential to ensuring effective DER contribution to any black start solution

The panel also noted the potential ultimately for DER solutions to enable either a faster response to a black start situation or to create pockets of resilience which would be of material benefit to consumers. National Grid have confirmed that they expect this project to provide learning around the development of microgrid-style community schemes that offer customers improved resilience and control over their energy.

(d) Is Innovative

The use of DER as part of a black start strategy has not been trialled anywhere on the GB network. The key innovative elements of the project relate to both the multilateral contractual arrangement and the resilient communication solutions necessary to ensure significant DER have the opportunity to play an active part in any black start solution.

While there is some international experience in the use of microgrids to improve resilience which National Grid will look to capture as part of the project, the use of DER to support black start is innovative on a global level.

(e) Involvement of other Partners and external funding

There are two other project partners each contributing 10% of the project costs.

SPEN (involving SP Transmission, SP Manweb and SP Distribution) provide the DNO and TNO link to the NG proposal. The Panel views this as a vital part of ensuring the output from the project is likely to be rolled out as BAU, and for the learning to be fully understood of how best to co-ordinate possibly significant numbers of DER by the DNO/DSO.

TNEI are the third party that submitted their project to the NG call, and provide generator technology expertise, specialist modelling and analysis capability of the GB transmission and distribution networks.

(f) Relevance and Timing

The ESO black start capability is relying on aging conventional assets that are increasingly expensive to keep available for dispatch. With more DER now available and offering the potential for a cheaper and lower-carbon solution, the project learning provides NG, the DNOs and DG owners the technical and operational evidence necessary to understand how and where DER can be introduced to the mix making it cheaper than the current conventional solution.

(g) Robustness of Methodology and ready to implement

As the project methodology intends to seek agreements with synchronous DER to form the core of the power island, and then to supplement the generation capacity of the island with windfarms, there is a high confidence that the method will progress through the analysis and desktop stages to successful field trials. It is possible that as information on other DER technology TRLs becomes available through a complementary NIA project, other technologies can be included in the trials.

The Panel were reassured that a refocusing of the work packages would ensure no unnecessary expenditure on their proposed demonstration projects would occur prior to fully understanding feasible options arising from the NIA project and the early design phase of this NIC project.

Conclusion

The Panel considered this innovative project would facilitate the transition to low carbon DER, delivering financial and wider benefits. Based on the evaluation the Panel recommends that the Authority agrees to fund Black Start from DER.

2.2 REVISE

Licensee	Western Power Distribution (West Midlands) plc
Total Project Cost	£12.571m
NIC Requested	£11.103m

The proposal

The on-going transformation of the electricity system, and the trend away from large centralised power stations towards distributed generation (DG), continues to drive significant increases in the number of generators connected directly to DNO networks. In particular there is now a large, and increasing, number of renewable wind and solar generators connected to the 33kV distribution system. The most common approach has been to connect new generators with a single T-connection into a nearby 33kV circuit. In order to minimise costs, the connection is generally configured with little or no switchgear, and this means that the generator loses access to the system whenever a fault occurs or maintenance is being carried out anywhere along the circuit. To-date, generators have found it economic to adopt these "constrained" connections, because the alternatives using existing switchgear designs are relatively expensive. These constrained connections have enhanced the rate at which DG is connected without creating significant additional infrastructure, but because generator downtime is higher, it results in a loss of low carbon energy that would otherwise be supplied to the GB system.

It is proposed to develop a low-cost packaged 33kV substation, an Advanced Connection Solution (ACS), that allows the network to be reconfigured and generator downtime, caused by network maintenance or outages to be minimised. Further, by automating these substations, it would also be possible to reconfigure the 33kV network in real-time, both to minimise generator outages and to increase effective network capacity through dynamically re-routing power flows away from overloaded parts of the system. It is proposed to develop an Intelligent Network Reconfiguration (INR) to do this.

Lastly, as an enabler, the project also proposes to develop a Dynamic Protection System (DPS). Power systems are monitored by a number of devices that can identify when a fault or dangerous condition exists on the system. When this occurs, these protection devices issue instructions to circuit breakers and other devices to allow the faulty part of the system to be disconnected (a statutory duty on any person owning an electrical installation). The configuration and settings of these protection devices are usually fixed to match a static power system configuration, and while sub-optimal under abnormal

operating configurations, fixed protection is generally acceptable. This however requires a number of rules are in place to ensure that the power system is not so complex that it cannot be protected. Self-configuring protective devices and protection schemes such as the proposed DPS could therefore release network capacity by facilitating INR.

In summary:

Method 1 (ACS) will address the packaging of switchgear to create cheaper flexible turn-in arrangements for connections. This could make these new flexible arrangements significantly cheaper than the current equivalent arrangements.

Method 2 (DPS) will investigate the automated calculation of new settings for different network configurations and the automated implementation of these settings on relays out on the system.

Method 3 (INR) will develop new machine learning techniques for analysis of networks with multiple in-feeds (run in parallel or with normally open points) to determine the optimal running arrangements. The proposal is that several parameters can be considered for optimization, including generation output, losses, security. The automated analysis will access the DNO's network management system through an interface to configure the network in line with the optimal analysis.

Panel's Assessment of the criteria

(a) Financial, Carbon and Capacity Benefits

Financial benefits

WPD estimate the financial benefits arising from REVISE at full roll-out across the GB network are £14 million by 2030 rising to around £190 million by 2050 (NPV terms). However, this estimated value is somewhat skewed. It is only INR that is anticipated to deliver a positive value in both 2030 and 2050; £75 million and £209 million respectively. ACS will not produce a positive NPV by 2030 and DPS remains negative throughout.

Both the DPS and ACS equipment are required to deliver the INR benefits claimed in the NIC bid. Consequently, it is the benefits arising from INR that are key to delivering value overall.

The INR counterfactual is delivering additional reinforcement delays over alternative ANM options. The panel questioned whether this incremental benefit was justified given the £11 million of NIC funding.

The base case assumes WPD would deploy this arrangement across 36% of their own network by 2050. However, given that no other DNO is working in partnership on the project, the Panel is uncomfortable with the assumption, required to deliver all the claimed benefits, that penetration of the methods would match or exceed this level across the GB network.

The value of these benefits depends on a 10% and then 5% (ie, 15% fall in total from Method cost) fall in capex costs being achieved at roll-out stage. This assumption is also sensitive to the number of deployments needed to incentivise equipment and system suppliers to deliver standardised ACS products.

Carbon and Capacity Benefits

The ACS has the potential to deliver carbon benefits by reducing the length and/or frequency of periods when DG, including that from low-carbon sources, is curtailed. At their forecast level of uptake, and taking account of the differences in embodied carbon attributable to the ACS compared to a "traditional" connection arrangement, WPD estimate this benefit to be in the order of 0.8mt CO_2e by 2050. They forecast a further 1.3mt CO_2e benefit by 2050 attributable to the INR through a reduction (by 3 months) in the time taken to connect new DG. While these benefits would be welcome, they are dependent on the levels of uptake discussed above.

WPD have also referred to the environmental/amenity benefits of deploying ACS, arising from its smaller land take, to the point where- they suggested – planning permission might not be required. The Panel is not able to share their confidence in this aspect.

(b) Value for Money

WPD are seeking to apply competitive tendering arrangements to purchase the technology required for the trials. Whilst this gives the Panel some comfort on VFM, without an OEM in place, it was not possible to test the extent of the OEM market being able to deliver to the specification required at the price point set. Whilst the results of the RFI produced a price point used in the financial benefits

calculation, the Panel could not readily test the robustness of the assumed cost reduction that is necessary to achieve the GB roll out benefits.

The project involved significant spending on enablers to be able to test the INR aspect which the Panel felt was not VFM. Overall the cost of VFM represents 38% of the total project cost, the remaining 62% being spent on its enablers of ACS and DPS.

(c) Generates new knowledge

While the Panel sees merit in developing a low cost 33kV substation, it was not convinced that there weren't already conventional solutions available that would deliver substantially the same functionality as the ACS. It also questioned whether the best a DNO could do, if a customer requested an ACS-like connection today, would be to respond on the basis of a bespoke design using standardised buildings and equipment, intended for a 132/33kV Bulk Supply Point (in effect, WPD's counterfactual). WPD state that the innovation in ACS rests principally in packaging commercially available devices, some of which may not be in use in GB, into a compact space and designing a safe system for its operation, maintenance and connection to the overhead circuit. To the extent that learning is always gained from deploying new makes or models of switchgear on the network, the Panel recognises that new knowledge would be generated from the design and implementation of ACS.

See section on Innovation for potential new knowledge gained from DPS and INR that could be shared.

(d) Is Innovative

ACS achieves the functionality of a simple 33kV ring main substation which is not in itself innovative. Furthermore, it is not clear that deploying already available equipment types, to meet cost and space constraints, goes beyond what is to be expected in the normal course of business when DNOs introduce new models of switchgear or transformer to their networks, often in pursuit of procurement efficiencies. The Panel therefore does not consider ACS in itself to be innovative.

DPS appears to be innovative to the extent that selection of the appropriate protection scheme from a multi-capable relay system would be autonomous. The deployment of multi-capable relay systems

is not new, nor is selecting alternate settings in real time, but it does appear that selecting alternate schemes and settings autonomously in real time in relation to system changes has not been demonstrated before.

INR is innovative by seeking to reconfigure the 33kV network dynamically and automatically. The other innovation is that the objective of INR is to maximise network capacity for any given asset availability. Existing network reconfiguration generally operates post fault as opposed to any other system change trigger, and generally optimises for system security only. INR adds the functionality to optimise for other criteria and from other triggers than faults.

The Panel were not convinced that the project, while offering some insights into new technologies and deployments, was sufficiently innovative over BAU alternatives to justify funding.

(e) Involvement of other Partners and external funding

WPD have chosen not to involve other Partners in this proposal. They argue better VFM is likely with competitive tendering with OEM suppliers once there is a firm proposal to be market tested. The Panel is not necessarily convinced that this was the best way of ensuring VFM for the customer given the level of funding requested.

The Panel noted letters of general support from renewable generators, but consider the proposal was weakened by the absence of a generator partner. Generators are the clearest beneficiaries of ACS and therefore their willingness to pay the higher costs of connection would be decisive in relation to the success or otherwise of the roll-out of ACS.

Without any other DNO as a Partner, the Panel is unconvinced that other DNOs would so readily adopt the solutions into business as usual. Given the existence of other potential solutions to the problem being tested, the panel considers the 30-40% GB rollout target a hard one to deliver.

Whilst the NIC is a competition, it is one for ideas rather than between DNOs. Given there are adequate funds available, the Panel is keen to see collaboration of effort.

(f) Relevance and Timing

The increasing complexity of the network, and the financial and environmental imperative to keep DG connection costs down while maximising low carbon generation, mean that this project is looking to address what the panel recognises is a live issue. Delivering a mechanism that maximises the utilisation of the existing network via real-time reconfiguration would be an attractive and timely solution.

(g) Robustness of Methodology and ready to implement

The Method trials appear under developed. In particular, the Panel is concerned about how risks may be mitigated in the delivery of the critical comms and cyber security requirement. In addition, the Panel was not convinced that the ACS design challenges will be delivered within the cost proposed. Descoping the trials is how WPD would manage these cost challenges which, in the Panel's view, would not be acceptable.

Conclusions

The Panel is unconvinced about the extent of the overall innovation in this project and the likely level of benefits projected to be achieved across GB, and so is not recommending it to be funded by the Authority.

2.3 CHARGE

Licensee	SP Manweb plc (SPM)
Total Project Cost	£8.545m
NIC Requested	£6.85m

The proposal

A substantial portion of road transport is expected to be converted to electric vehicles (EVs) and has the potential to double electricity distributed by the existing networks. The project considers how the mapping of road journeys, modelling of customer behaviour, and knowledge of electricity network capacity can be combined to facilitate a more rapid and efficient deployment of EV charging infrastructure.

The choices available to developers of charging infrastructure are principally around location, the number and capacity of chargers, and the demand profile they present to the DNO network. The project addresses different types or configuration of EV charger provision specifically, on-street parking in residential and city-centre areas, high capacity "en-route" rapid charge facilities, and "destination" chargers.

Unless it is carefully planned the rate of uptake of EVs, and the associated charging equipment in some areas, could exceed the rate at which supporting electrical infrastructure can be developed. It could also turn out to be much more expensive than necessary.

Major DNO infrastructure upgrades can take up to 5 years to deliver if consents are required. A parallel can be drawn with the rapid installation of distributed renewable generation and lessons could be learnt from that about the need for DNOs to be pro-active. The learning from CHARGE aims to provide information about existing network capacity and the relative costs of connecting different types of EV charging infrastructure at different locations across their service areas.

At present DNOs have an obligation to respond timeously to applications for a new or enhanced connection. The distribution licence requires them to provide network information as part of the application process, but it could be argued that this historic process is insufficiently flexible to manage the anticipated volume of applications for EV charging infrastructure efficiently. A need exists for infrastructure developers to be able to explore how they can optimise costs, through in particular,

taking the right decisions on site selection and charger ratings, and/or the use of time-of-day profiles or other demand flexibility. This is currently a stumbling block for developers who can struggle to engage strategically with DNOs regarding the cost effective development of EV charging infrastructure.

This project addresses these issues through application of three Methods:

- Method 1: Strategic transport and network planning: How to overlay mapping of demand for transport (customer journeys) with availability of electrical network capacity. This would allow DNOs to anticipate the locations of specific growth in demand due to EVs, especially for the relatively high capacity "En-Route" and "Destination" charging infrastructure. It should therefore inform their investment plans for 33kV and above, and allow them to engage early with potential developers.
- Method 2: Tactical solutions to support EV connections. This will assess the range of methods and technologies available to provide the charging capacity, principally for two cases: domestic charging for the one third of homes without driveways and destination/en-route locations.
- Method 3: Development of a "ConnectMore" software tool to provide developers with an on-line and highly localised view of the best locations for charging infrastructure and the constraints existing at those locations. The Method will take into account the detail of the network at 11kV and LV aiming to improve existing tools by adding information relevant to flexible connections.

Panel's Assessment of the criteria

(a) Financial, Carbon and Capacity Benefits

Financial benefits

SPEN estimate that the financial benefits arising from Charge by 2030 will be in excess of £135 million, and £795 million by 2050 (NPV terms).

Method 1 is projected to deliver £51m and Method 3 £77m by 2050 (NPV terms), with the balance in Method 2. Whilst the methodology applied by other DNOs may not exactly mirror those used in the NIC proposal, there will nonetheless, be benefits arising from better planning of DNO and non-DNO infrastructure investment.

Understanding transport use patterns under Method 1 should offer DNOs the evidence to support prioritisation of necessary reinforcement investment (eg. to ensure that planning and preparatory works are carried out early enough, and that network enhancements are commissioned in time to avoid delays to the rollout of charging infrastructure). Method 3 ensures the investment undertaken by non-DNOs (eg. EV charge owners and private developers) benefits from cheaper connection costs where capacity exists on the network.

This project is affected by all the uncertainties associated with the uptake of EVs; both on the upside as well as the downside. The benefits from Method 2 may also be over-estimated since optimisation of investment under the proposal will not take account of locational, financial and overall willingness-to-move limitations to which charge point providers and users will be subject.

Notwithstanding these issues, the Panel accepts that the financial benefits of this Method are still likely to be substantial.

Carbon and Capacity Benefits

SPM forecast a carbon saving of 5.5mtCO_2e by 2050, as a consequence of their project encouraging the uptake of EVs, specifically by tackling the barrier known as "range anxiety". This forecast, although derived in a reasonably cautious manner, is not disaggregated by method and is very uncertain because, as noted above, so many other factors could influence the adoption of EVs. However, given the UK's policy commitment to wider adoption of EVs, the Panel is satisfied that the potential for carbon savings supports the case for the project.

The Panel has explored with SPM the potential for wider land-use planning benefits arising from Method 1, and to an extent Method 3. It believes that such potential exists and that, in principle, a project that encourages greater consideration of electricity network infrastructure in land-use decision-making and vice versa is to be welcomed.

(b) Value for Money

SPM carried out a third party call for ideas for NIC 2018, which is the basis for EATL and SGS project partners' involvement and contributions. PTV were subsequently selected by SPM, EATL and SGS as being the dominant software provider for strategic transport planning in the UK. The Panel is concerned about the lack of competitive tendering for the PTV element but is reassured that their

presence in the market was likely to influence the speed of uptake of the final solution. Overall the Panel views the composition of the team as offering VFM.

Following the ISP, SPM undertook significant stakeholder engagement to assess the appetite for a co-ordinated approach to facilitating electrification of transport. This offers a cost effective platform for roll-out of learning from and engagement with the proposal.

SPM have also committed to self-fund a car club to ensure charge point usage provides realistic and statistically relevant results.

Any charging infrastructure hardware will not be procured by the NIC funds.

As a consequence of collaboration between SPM and LPN on their complementary NIC proposal Optimise Prime, project costs have been reduced without learning being lost.

The project will conform to the default IPR principles of NIC, which recognise that technology providers' background IPR is protected. All foreground IPR developed by the project will be freely available for deployment to other DNO areas. In particular, EATL will make the ConnectMore tool free to all GB electricity licensees and stakeholders. The new methods developed will be fully disseminated.

(c) Generates new knowledge

The project aims to test behavioural and demand management approaches to manage load as a means of offering DNOs opportunities to target infrastructure reinforcement.

Traffic planning tools are not new, but to-date they have not formed part of the process used by DNOs in GB to plan investment in their network, nor to inform EV developers of cost effective charging point locations. The new knowledge created by Method 1 is to do with leveraging information about customer journeys into the demand for, and location of, EV charging facilities and how this maps to the investment required to reinforce the DNO's network. It is possible that this learning may help to identify "hot spots" of demand and shortage of capacity early and then to work with developers to arrive at a less expensive overall solution.

Method 2 should generate learning about the practicalities of installing EV charging infrastructure to serve the one third of households who do not have off-street parking. It will also reveal the willingness of infrastructure developers and end-users to respond to signals, such as price or variable charging speeds, and to prove how effective these are as solutions. The outputs will include data to inform financial appraisals of different "smart" charging solutions, guidelines to DNOs and charger equipment manufacturers and those developing planning and network development policy on what is required for roll-out, and how best to provide information to end-use customers, that encourages them to make effective use of the systems. While the Panel was initially concerned about the lack of a clear delineation between the role of the infrastructure providers (who are the DNO's customers) and end users, they accepted that SPM's focus would be on its direct customers and that any learning on end user behaviour change would come through SPM's direct customers.

Method 3 offers learning around the development of a reliable process to manage the large volume of granular data produced from the LV network for use by external parties.

(d) Is Innovative

While there have been a number of previous EV studies they have focussed on home charging. The issues around on-street, en-route and destination charging have not been explored before.

The Methods are each innovative in different ways.

Method 1 innovates by combining transport and network planning for an entire DNO service territory for the first time in GB.

Method 2 aims to innovate by seeking to incentivise infrastructure developers to site, design, and profile their demand in ways that take account of DNO network reinforcement costs and timescales. Unlike in generation, where flexible (or non-firm) connections are commonplace, flexible demand connections are relatively rare in GB, and typically DNOs provide connected parties with a constant maximum capacity. It will also test customer response to charge "speeds" ranging from timed or fixed through to variable in real-time, driven by real network limits. It will also explore how variable EV charging demands might be integrated with other flexible resources connected at the same or nearby location, such as street lighting or batteries. This will offer new learning in how to establish charging profiles for EVs in the various locations being tested eg. residential with no off-street parking, as well

as destination and en-route chargers, which is in addition to what is already known from other innovation projects.

Under Method 3, the "ConnectMore" tool will make it easy for EV infrastructure providers, new land planners and developers etc to gain a better understanding of where adequate network capacity exists and so make it more cost effective for the roll-out of new EV charger networks.

(e) Involvement of other Partners and external funding

There are three other project partners that are making a financial contribution to the project. EA Technology (EATL) is contributing £0.299m, Smarter Grids Solutions (SGS) is contributing £0.15m and the PTV Group is contributing £0.123m (all partly in-cash and partly in-kind).

SPM believes the knowledge and experience provided by each of these external partners will ensure the technical requirements in delivering the project are both well understood and delivered.

The Panel were pleased to see the extent to which local authorities appear to be keen to assist in the development of this proposal. Key to their formal participation will be their ability to access other government support currently available for the roll-out of EVs across GB.

The Panel noted that there is no other DNO partner involved. The fact that SPM will be able to utilise their two licence areas is helpful but collaboration with another DNO would have increased the Panel's confidence that the solution would be rolled out across GB.

(f) Relevance and Timing

The development of a cost effective network of EV chargers network may be constrained without collaboration between local planners and developers, EV charge owners, and DNOs to ensure the electricity network is not developed in a piecemeal fashion.

The drive for greater EV penetration is currently being driven by UK policy that envisages EVs being key to reducing transport emissions.

The trials will overlap with the RIIO2 process and it is anticipated that learning and evidence gained during the trials may provide better evidence in support of SPM's RIIO2 infrastructure reinforcement plans.

(g) Robustness of Methodology and ready to implement

Given the trials are key to understanding how the tools will offer the learning anticipated, the Panel was concerned about a lack of financial contribution from end users (eg, local authorities, charge point owners etc). SPM offered the Panel additional information on the extent to which a wide array of possible end-user partners have engaged to date and their stated willingness to participate should the proposal receive NIC funding.

SPM also confirmed if they had difficulty in securing new charge points, local authorities with existing charge points would be available as a cost effective back-up.

In addition, there was assurance given on the potential to capture behavioural lessons by extending customer engagement in particular in Method 2.

The Panel were therefore reassured that adequate trials would be possible to deliver the learning proposed.

Conclusions

The Panel believes this project is timely, offers VFM and should provide much needed evidence to facilitate the roll-out of EV charging infrastructure across GB.

It is also reassured that pre-submission collaborative activity secured VFM. However, in the absence of another DNO partner, as part of their recommendation, the Panel would expect SPM to consult closely with all DNOs to ensure the learning has wide applicability across GB prior to trial site selection.

The Panel therefore recommends to the Authority to fund this NIC proposal.

2.4 OPTIMISE PRIME

Licensee	London Power Networks plc
Total Project Cost	£34.691m
NIC Requested	£16.399m

The proposal

Fleets of commercial EVs and private hire vehicles (PHVs), as a class of EVs, are expected to create the larger proportion of the additional demand on electricity networks from EVs. In particular, as they consume more energy (both as total miles per vehicle and as energy per mile), there may be less flexibility about when charging is to be done and there may be greater clustering of chargers at, for example, large depots that vehicles return to for charging.

If commercial vehicles, such as those used by "home-based" staff, are recharged at domestic premises there is a risk that this leads to higher socialised costs driven by the DNO's need to reinforce its networks as the cumulative impact exceeds available capacity. For large depots, the installation of chargers, particularly if ultra-fast chargers are used, could face long delays while the DNOs carry out expensive network reinforcement, which imposes high costs on the commercial fleet operator, as well as some element of reinforcement costs being socialized to all customers. In both cases these issues could well be a drag on the rollout of EVs which will have a detrimental impact on the decarbonisation of transport.

This project addresses the impact of commercial EVs on electricity networks by considering those that may return to domestic premises for charging and separately those that will be clustered at depots. By working with three of the largest fleet operators in GB the project aims to generate significant practical learning about this sector of the EV market.

Method 1 will study the impact of commercial EVs on the domestic charging demand. In Method 1 the commercial EV demand will be physically segregated from the customer's domestic usage, enabling it to be managed separately, including an assessment of its flexibility for participation in DSR schemes.

Method 2 will investigate for clustered commercial EV charging at depots, how knowledge of the vehicle fleet's usage patterns can be used to optimise the capacity of the site connection. This will assess the types of charging needed for the mix of EVs on site, and calculate a site capacity

requirement based on a managed demand profile, typically over 24 hours, instead of the current practice of designing to a higher "worst case" estimate of (unmanaged) peak demand. An enduring tool is also being developed so that the depot can manage its on-site charging demand, by using behind-the-meter equipment, to maintain overall demand within the agreed daily profile. This tool will be freely available for public use after the project, and will be capable of being further customised and developed by third parties. The project will also develop pro-forma commercial arrangements that could be used in rolling out this Method.

To better understand the degree of flexibility that can be provided, the following parameters will be studied:

- Cost: to determine the price point at which flexibility becomes attractive for fleet operators
- Magnitude: to determine the volume of aggregated demand that can be treated flexibly
- Duration flexibility might be available
- Responsiveness of providers
- Proximity: period over which the contract is offered
- Make-up: availability and utilisation payment value balance
- Predictability

Panel's Assessment of the criteria

(a) Financial, Carbon and Capacity Benefits

Financial benefits

LPN estimate that the financial benefits arising from Optimise Prime by 2030 will be in excess of £200 million, and £485 million by 2050 (NPV terms).

Given the continued level of uncertainty over how quickly fleets convert to being predominately or wholly EVs, these financial estimates have to be viewed as being equally uncertain. The project assumes a 7-fold increase in EVs sales by 2030 (compared to 2017), with the uptake ramping up quickly from 2020 as the cost of EVs becomes comparable with the Euro6 Diesel alternative. The largest share of these sales is assumed to be commercial vehicles.

However even under the low uptake scenario, the NPV benefit by 2050 is still in excess of £100m. Financial breakeven is projected to occur around 2026-27.

Carbon and Capacity Benefits

LPN forecast a carbon saving of more than 4mtCO_2e by 2050, as a consequence of their project accelerating the purchase of EVs, in place of conventional vehicles, by fleet operators. The Panel considers this scale of benefit to be very uncertain, not because the project lacks the potential to stimulate EV uptake but because there are so many other factors, outside the project partners' control, which could have the opposite effect. However, given the UK's policy commitment to wider adoption of EVs, the Panel is satisfied that the potential for carbon savings supports the case for the project.

The project also has the potential to reduce emissions of NOx, other pollutants and noise associated with conventional fleet vehicles, compared to levels currently experienced.

There could be some limited capacity benefits, chiefly in respect of the home charging trials, which will be of benefit to the network and, depending on location, to low-carbon generators.

(b) Value for Money

A key VFM benefit from this project is being able to capitalise on project partner fleets being converted to EVs rather than Euro6 alternatives, ie, NIC monies are not being used to fund any of the cost of the EVs.

As a consequence of collaboration between LPN and SPEN on their complementary NIC proposal CHARGE, project costs have been reduced without learning being lost.

A competitive procurement approach is being used in securing VFM where there are several competent suppliers available to deliver external research and analysis, hardware and associated services.

Hitachi proposed the project to LPN through a competitive innovation process which fits with Ofgem's RIIO-2 Framework aimed at increasing third party engagement in innovation. They are providing project management in this lead role and are contributing £4.36m to the total project cost (just over 12%). In addition to their project management role Hitachi is providing an IT platform combined with data governance and data analytics (building on knowledge gained from their own, large (over 80)

fleet customer base). The Panel is content that given this wide ranging role, Hitachi's contribution does represent VFM.

(c) Generates new knowledge

The proposal aims to provide new learning about if, and how, the charging requirements of EV fleets can be managed to avoid potentially very high costs of DNO network reinforcement. It also aims to explore how fleets can secure revenues from providing cost effective flexibility services, thereby promoting a more rapid rollout in support of the decarbonisation of transport.

Separation of commercial EV demand connected at domestic premises, from underlying domestic demand, will both provide knowledge about the impact of EVs on networks serving residential areas, and enable suppliers and aggregators to develop energy management products for this market. The viability of these products is expected to be underpinned by the ability to understand and harness EV charging flexibility.

UBER are providing car usage data that offers the network learning on how such dispersed and individual owner commercial vehicles (providing transport as a service) may operate in an EV world.

The use of different charging options and incentives should provide DNOs and DSOs evidence on how to develop optimal DSR strategies and provide EV fleet owners with evidence on the possible benefits from different metering arrangements and optimisation of energy use.

Finally, the proposal offers the potential for DNOs and users to learn how to work using price signals to minimise reinforcement and connection charges.

The Panel is reassured that the knowledge gained from this will be readily available to all possible users.

(d) Is Innovative

Using vehicle telematics and mileage data to understand the total daily charging requirements at an EV fleet depot, and then using this to size the site network connection and define the optimal daily demand profile is innovative.

Currently, responding to new electricity demands of fleet EV owners has the potential to result in stranded assets (as a consequence of fleet owners over specifying network need), and leave fleet owners with unmanaged, higher network costs. Optimise Prime allows DNOs and fleet owners to assess and test the potential to be gained from flexibility services derived from new behind the meter solutions to mutual benefit.

(e) Involvement of other Partners and external funding

The Panel is pleased to see LPN has included 6 other Partners in this proposal. Together, they are contributing £16.25m, 47% of the total project cost.

SSEN's input gives the Panel increased comfort that the learning is more likely to be used by all the other DNOs.

Royal Mail and Centrica are large fleet users who clearly see the value in being involved with the project learning, thus aiding their own transition to a low carbon fleet option. The Panel was initially concerned that these very large fleets might not be wholly representative of fleets across GB, but was reassured by the fact that each has in itself a diversity of vehicle use, due to national geographic coverage, and a widespread distribution of depots. The trials will capture data based on 15-20 depots. Additional reassurance was provided by Hitachi offering to carry out a survey of Hitachi Capital's customers (over 80 fleets comprising 23,000 vehicles) to validate the findings.

UBER's participation offers the network access to car usage data for at least 1,500 vehicles.

Hitachi won a competitive call by LPN for Innovation Ideas. They are leading the project, providing the project management, IoT platform, and data analytics capability, and are responsible for developing the tools to facilitate the home charging trials, depot site planning, profiled connection design, and depot optimisation.

(f) Relevance and Timing

As the industry seeks to accommodate a step change in the uptake and use of EVs, Optimise Prime offers a managed approach to understanding how best to ensure the network does not constrain that

uptake. It also ensures the network owners have the evidence that supports their reinforcement plans which is currently hard to justify.

(g) Robustness of Methodology and ready to implement

The Panel was initially concerned to ensure that any foreground IPR generated by Hitachi on its data analytics and IoT platform would be fully available for others to use at the end of the project. This includes the datasets and algorithms developed for the home charging trials, depot site planning, profiled connections and depot optimisation. While these will be openly available for others to apply in their own platforms, the project has assured the Panel that, at the end of the project, there will be versions of the relevant tools available that can be accessed directly by third parties. Users are expected to include other DNOs, charging infrastructure developers, depot owners, suppliers, and consultants.

The platform being deployed on this project will build on Hitachi's already tried and tested IoT solutions which gave the Panel comfort that the Methodology is robust.

Conclusions

Given the timeliness, the VFM and the extensive collaboration involved in this proposal, the Panel recommends that the Authority funds this NIC proposal.

In making this recommendation, the Panel would expect the Authority to be reassured that all project partners have reached commercial close on their contributions as outlined in the Full Submission.

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)
Black Start from DER	National Grid Electricity Transmission plc	10.04
Charge	SP Manweb plc	6.85
Optimise Prime	London Power Networks plc	16.399

Unable to recommend funding

Project	Licensee	NIC Request (£m)
Revise	Western Power Distribution (West Midlands) plc	11.103

4 ACKNOWLEDGEMENTS

As in previous years, the Panel fully recognises the amount of work required to make ENIC 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 of 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 what was a relatively new 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.