ELECTRICITY NETWORK INNOVATION COMPETITION 2017

REPORT AND RECOMMENDATIONS

Prepared for

THE GAS & ELECTRICITY MARKETS AUTHORITY

By

THE ELECTRICITY NETWORK INNOVATION COMPETITION EXPERT PANEL

October 2017

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 2017 NIC funding round.

1.1 Panel Membership

Members of the ENIC 2017 Expert Panel are:

- Jo Armstrong (Chair)
- Alan Bryce
- Jeff Halliwell
- Prof Nicholas Jenkins
- Jiggy Lloyd

1.2 ENIC 2017 proposals

There were seven submissions made to the 2017 ENIC which, collectively, bid for £63.91 million of the £70 million NIC funding that was available. 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:

- Power Saver Plus (PS+)
  Licensee: Electricity North West Limited (ENWL)
  Total Project Cost: £8.19 million
  NIC requested: £7.02 million

- Holistic Active & Reactive Power (HARP)
  Licensee: Western Power Distribution – East Midlands (WPD)
  - led by Mott MacDonald
  Total Project cost: £16.38 million
  NIC requested: £14.45 million

- LV Engine

  Licensee: SP Manweb (SPM)

  - partnered with UK Power Networks

  Total Project cost: £8.30 million

  NIC requested: £7.29 million

- Active Response

  Licensee: London Power Networks (LPN)

  - partnered with SP Energy Networks (SPEN)

  Total Project cost: £18.30 million

  NIC requested: £13.83 million

- TRANSITION

  Licensee: Southern Electric Power Distribution (SEPD)

  - partnered with Electricity North West Limited (ENWL)

  Total Project costs: £14.70 million

  NIC requested: £13.08 million

- FUSION

  Licensee: SP Distribution (SPD)

  Total Project cost: £5.97 million

  NIC requested: £5.29 million

- Electricity Flexibility & Forecasting System (EFFS)

  Licensee: Western Power Distribution – East Midlands (WPD)

  Total Project cost: £4.31 million

  NIC requested: £2.94 million

1.3 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 POWER SAVER PLUS (PS+)

2.1.1 The Proposed Project

POWER SAVER PLUS (PS+)	
Licensee	Electricity North West Limited (ENWL)
Total Project Cost	£8.19 million
NIC Requested	£7.02 million

The loading on the distribution network is expected to increase particularly due to the growth in low carbon loads (e.g. electric vehicles and heat pumps) and the increase in PV generation. These increases in load are likely to be clustered creating both voltage and thermal problems at points on the 11kV and 400V networks.

The PS+ proposal is to trial the effectiveness of having the DNO deliver energy efficiency programmes to customers, and targeting these on reducing peak demands on the distribution network, as an option to traditional reinforcement which would otherwise be needed to connect low carbon technologies.

Trials will be undertaken to investigate the effectiveness in reducing energy demand and peak loads of the following energy efficiency measures in domestic premises, either individually or in combination:

- energy efficient appliances
- high efficiency electric heating
- energy efficient lighting
- customer behaviour modification

In addition to this, the trial will also install:

- solar PV on municipal buildings
- solar PV on MV/LV substations
- energy efficient street lighting
- combined measures

The PS+ proposal builds on a previous project undertaken by ENWL, namely, Power Saver Challenge and aims to take a whole systems approach by recognizing not only the individual electricity customer benefits but also the wider societal benefits arising from energy demand reduction.

As well as releasing network capacity, the benefits anticipated from the trials include reducing domestic energy consumption and hence bills, and compensating for network losses using PV generation at secondary substations.

In order that the wider benefits of energy efficiency measures to electricity consumers are recognized, the project proposes the development of an enhanced CBA model to be used together with the Power Saver+ tool by planning engineers when comparing solutions to network overloading. The CBA model would be used to justify RIIO-ED2 business plan propositions.

2.1.2 Financial, Carbon and Capacity Benefits

The deployment of the various power saving measures being trialled across GB are anticipated to lead to lower or delayed levels of more expensive traditional reinforcement of the network.

Financial benefits

The financial benefits from applying a combination of the energy efficiency measures were estimated to be considerable. By 2050 the GB level of benefits is projected, by ENWL, to be £350 million (in NPV terms).

The key assumptions used to generate these benefits are:

- The weighted average cost of traditional reinforcement per representative substation asset is projected to be £233k (2017/18 prices) based on evidence from actual network costs of various possible traditional intervention types;
- 72% of GB LV circuits were deemed eligible candidates for reinforcement / replacement with a scaling factor of 13.28 being applied to the PS+ trial results to generate GB-wide results;
- The proposal was stated to breakeven by 2028, or 10 years after project initiation. This assumes 15,300 individual deployments will have successfully been undertaken.

Whilst the potential benefits at the GB level may be large, there is no guarantee that they can and will be distributed in an equitable manner even though they are being paid for by all DNO customers.

More concerning for the Panel was the lack of clarity offered on the underlying benefits case for each intervention type or how the interventions suggested would deliver the reduction in peak demand that justified the use of the counterfactual of reduced reinforcement costs; particularly so for the PV case.

Carbon and Capacity Benefits

In principle, managing the demand for electricity with measures such as energy efficiency has the potential to generate carbon benefits and is therefore to be welcomed.

With this proposal, at least some of the capacity released by demand management can be expected to enable the connection of low-carbon technologies. Since it is evident that the carbon cost of the demand management measures deployed (although not zero) would be lower than that of traditional methods of creating capacity, there is potential for considerable carbon benefit overall. However, the precise scale of these benefits would depend on the scale and location of actual demand reductions achieved. The Panel was not persuaded that demand reductions would necessarily be achieved in locations which had capacity constraints inhibiting the connection of low-carbon sources.

To the extent that demand is simply reduced, and/or the creation of new capacity is deferred, the carbon benefits would be commensurate with the energy savings achieved, including those

attributable to reduced network losses. The applicants have provided an estimate of the carbon benefits achievable in this manner but the Panel notes that this estimate does not reflect the intention of releasing capacity.

2.1.3 Value for Money

The financial contribution from ENWL (and partners) of £1.076 million is more than the 10% minimum required by the ENIC Governance arrangements, offering customers some level of value for money.

The involvement of consumers in optimising network capability is welcome in principle. However, it was disappointing to see limited evidence of drawing on latest thinking and best practice from other sectors or walks of life in achieving sustained consumer behavioural change, which is proposed as an important mechanism for reducing energy consumption.

The rationale for GB consumers wholly funding scrappage schemes, that would provide a direct and significant financial benefit to a smaller number of consumers who happen to live in stressed network areas, was not convincingly explained.

The Panel was also concerned about the social equity of the approach being proposed if, as seems likely, action were to be focussed in the higher-income areas where capacity constraints due to use of PV, EVs etc often occur.

In particular, there appears to have been limited engagement with OEMs and retailers who would be also be financial beneficiaries of such a scrappage scheme, and who would be very likely willing to make at least a partial financial contribution. This undermines the value for money aspect of the scheme.

With the possibility that at least some consumers would be tempted to cash in their financial benefit by quickly reselling their new white goods, the general public acceptance of this programme appears to be problematic.

The Panel also remained concerned about the costs of some of the consultants' input.

2.1.4 New Learning

The project sponsor anticipates three distinct areas of new learning from the project:

- The development of an understanding of the most effective ways of encouraging users to reduce energy demand including an understanding of the price points that will stimulate customers to change their electricity devices in favour of more energy efficient ones;
- how to use energy efficiency measures as part of a DNO's network planning activities to provide an alternative to more costly network reinforcement; and,
- how to monetise wider societal benefits and to capture them in a reconfigured Ofgem CBA model as a means of providing evidence to support the RIIO-ED2 business planning process.

The Panel was not convinced of this new learning. First, there is already an extensive body of knowledge from across the UK utility sector on how customers can and will respond to various interventions and incentives. Secondly, the development of a more general CBA Model is not new; the Treasury Greenbook already clearly identifies the potential for, and the means of how to monetise wider, non-direct and indirect project benefits.

2.1.5 Innovation

The PS+ concept is innovative for a DNO as a means of assisting energy efficiency (i.e., a reduction in overall energy consumed, kWh, rather than peak shifting). Energy efficiency has traditionally been the concern of energy suppliers through, for example, the Energy Company Obligation (ECO) scheme. Any overall reduction in energy use leads to a range of benefits including reduced need for network capacity, reduction in losses and lower consumers' DUoS and energy bills. The Panel recognised the importance to society of encouraging energy efficiency measures. However, the wider benefits projected to be delivered by PS+ will not readily be captured in any DNO's individual investment appraisal, nor by the totality of network customers who are funding the measure, thus the need for the development of an enhanced CBA model, to encompass factors that are not within the current business remit of DNOs.

So, the innovation is the combination of a Power Saver Tool that will allow planning engineers to rank and compare solutions to network overloading compared to traditional measures, and

an enhanced CBA model that assess the wider benefits projected to be delivered across the GB economy.

The Panel was not convinced of just how the Power Saver Tool would be effectively deployed by network planners given the significant challenges that would be required to ensure effective and enduring consumer engagement. Experience in other sectors suggests that, to generate a response than can be relied upon when planning service provision, contact with consumers must be intensive and specific to the proposition under consideration. The skills required by network planners to get comfortable with and use such a new approach and the timescales needed to be able to deploy energy efficiency measure rather than the better known, traditional reinforcement approaches are not discussed. The Panel feels any meaningful use of such a radically different approach requires careful consideration of just such issues.

2.1.6 Involvement of other Partners

The project will be undertaken by ENWL supported by project partners: BRE Consulting, Energy Saving Trust, Delta Energy and Environment, University of Salford, Impact Research, NERA Economic Consulting. None were proposing to make any direct financial contribution.

There are no other GB DNO licensees involved. More problematic for the Panel, however, was the lack of any meaningful engagement with suppliers of energy efficiency equipment. The PS+ proposal has budgeted c£2 million for the appliances in the trial. The potential for engaging with equipment suppliers was discussed in the bi-lateral meetings but not thought desirable. ENWL's experience gained from its earlier Power Saver Challenge initiative indicated such an arrangement would dilute the ENWL trial offering thus negating the evidence needed to develop the Power Saver Tool.

Just as important for the Panel is the lack of any written evidence of any formal support and involvement by BEIS. For the Power Saver Tool to be a BAU tool rolled out across the GB network, Government policy changes would be required. Without BEIS involvement, the Panel felt unable to assess the extent to which the learning from PS+ would be relevant to ensure such policy changes would be forthcoming in the timescale necessary for RIIO-ED2 planning (see below).

2.1.7 Relevance and Timing

For a DNO to make use of the energy efficiency measures as proposed in PS+ as a means of releasing network capacity, a number of changes in regulation and practice are likely to be needed:

- If the UK Government's ECO funding is to be used to provide financial support to secure the necessary energy efficiency measures proposed there will be a requirement for a change in who receives such funding. Unfortunately, ENWL did not offer any definitive statement from BEIS as to the extent they would be wholly supportive of any such proposed changes;
- Ofgem and all the DNOs will have to agree to the application of the enhanced CBA model as a means of capturing the projected wider energy efficiency measures. Irrespective of the extent to which Ofgem and DNOs offer such support, the challenges inherent in achieving a commonality of views (assuming such unanimity is possible) on the value to be attributed to the currently, non-monetised benefits (and possible costs) makes this a non-trivial issue not fully explored. Developing a simple clear and universally accepted change to the network planning standards is likely to be very time-consuming;
- Additional funding allocations for all DNOs via the RIIO-ED2 settlement will be essential to make this approach to demand management an affordable option to allow the full GB roll out. This requires Ofgem to agree to such a pricing approach which again was not fully explored in the submission.

2.1.8 Robustness of Methodology

The Panel was disappointed at the lack of evidence presented on the many consumer behavioural insights that are already available from research undertaken by other UK utilities. It was also unclear as to why the CBA modelling development work was not viewed as a business as usual element of ENWL's RIIO-ED2 business planning preparation. Finally, it was difficult to understand why some of the potential energy saving intervention methods would be viewed as efficient and a good alternative to traditional network reinforcement by a DNO's network planning team, especially where it is peak load rather than energy efficiency that is the challenge to be solved.

2.1.9 Conclusion

The Panel remain convinced of the need for and benefits of reducing demand as a means of delaying and /or reducing network reinforcement investment. However, it was not convinced of the merits of PS+ as a key mechanism in achieving such outcomes. It was not thought to offer VFM for the customer and challenges to customer equity could not be eliminated.

The Panel is therefore not recommending 2017 ENIC funding for the Power Saver Plus proposal.

2.2 HOLISTIC ACTIVE & REACTIVE POWER (HARP)

2.2.1 The Proposed Project

HOLISTIC ACTIVE & REACTIVE POWER (HARP)	
Licensee	Western Power Distribution (WPD)- East Midlands - led by Mott MacDonald
Total Project Cost	£ 16.38 million
NIC Requested	£14.45 million

The power flowing through a high voltage distribution circuit depends on the load connected and the inherent characteristics of the cables, lines and transformers. There is no active control of the flow through an AC circuit, in the way that a valve would regulate a flow of water. The result of this passive operation is that different parts of the network may not be able to be interconnected and, even where interconnection is possible, the power may not be routed so as to make best use of the circuit capacity. The lack of active control of power flows is a feature of transmission circuits but this limitation also applies to interconnected higher voltage distribution circuits (e.g. 66kV and 132kV).

The proposal is to manufacture and install a novel power electronic device, the Unified Power Flow Controller (UPFC) that controls the flow of power through a circuit. This ensures that it and the adjacent network circuits are fully loaded, but not overloaded, and so used most effectively. In addition to its ability to control power flows in a circuit, a UPFC can inject or absorb reactive power, improve power quality and modify short circuit levels. It is the most

flexible device within the family of power electronic equipment known as FACTS (Flexible AC Transmission System). The power electronic converters used are capable of very fast operation and so the UPFC can be controlled to respond rapidly to changes in network conditions and faults.

UPFCs were developed in the 1990s using early power electronic devices but were not widely applied. New power electronic devices and the increasing requirements being placed on high voltage distribution circuits by the connection of low carbon loads and generation now combine to make the proposal to trial a UPFC timely.

The project is to develop and demonstrate a UPFC to control 25 MVA power flow in 66kV or 132 kV circuits. 1 unit would be deployed at a substation in the WPD area.

2.2.2 Financial, Carbon and Capacity Benefits

The application of the UPFC onto the network is anticipated to be an alternative to more traditional reinforcement of the network.

Financial benefits

The financial benefits from applying the UPFC across the GB network are estimated to be £39 million (NPV terms), with £2.6 million projected to be achieved by 2030.

The key assumptions used to generate these benefits are:

- There are estimated to be 23 Grid Supply Points (GSPs) across the GB network where the application of a UPFC would meet the stressed, deployment criteria, i.e., they would eventually surpass the capabilities of alternatives such as ANM or DSR solutions;
- The capital cost of the UPFC will fall by 25% by 2040;
- Breakeven is reached by 2027, assuming 8 deployments of the UPFC, or just under 40% of the total of 23 that are deemed appropriate.

The issue of the potential number of deployments at the distribution level likely across GB (as distinct from England and Wales) was not clear. None were identified for the Scottish distribution networks.

The deployment of HARP offers the potential to sell reactive power services to GBSO. The financial NPV analysis does not attribute any such value, and although GBSO has indicated interest, WPD offered little by way of concrete evidence that should the UPFC trial be successful, at what price GBSO would or could engage in the purchase of such services.

Also, it was not clear to what extent the counterfactual should be traditional reinforcement rather than one, or a combination of, other already proven options e.g., Quadrature Boosters combined with STATCOM solutions. The Panel felt there was no compelling reason offered as to why the counterfactual is not the QB with STATCOM solution and so feel the NPV benefits of the UPFC solutions are unclear, especially without the GBSO formal involvement.

The challenge on costs is potentially greater given the need to secure land at the sites where the UPFC would be best located. Whilst potentially not a major cost, there is limited headroom in the base case NPV analysis, i.e. the benefit of the UPFC over traditional or other methods appears limited.

Carbon and Capacity Benefits

The capacity created by HARP would be less than that achievable through conventional reinforcement but may be created more quickly. Speedier delivery of new capacity might be welcomed by potential new generators and, if these were to be providers of low-carbon generation, there would be some benefit attributable to earlier displacement of generation from sources that emit carbon. However, it is not demonstrated that the stressed circuits selected for the intended 23 deployments are all those where there is urgent unmet demand for capacity for low-carbon connections and, as noted above, where such demand exists, it might be met by other means.

There would be a carbon cost associated with each installation, including that attributable to SF_6; no comparison with that of the counterfactual was provided. Because HARP offers the opportunity to meet capacity requirements in a more tailored fashion (i.e. avoiding over

provision or “stranded assets”) it is possible that in some deployments, the carbon cost per unit capacity provided will compare favourably with conventional reinforcement. However, this has not been demonstrated.

Landscape, amenity and other environmental considerations are relevant; it is in the Panel’s opinion debatable whether local communities would consider the installation of a UFPC a better or worse proposition than a programme of network improvement and reinforcement. However planning consent would be required in most if not all proposed locations and although community concern is a probable issue to be addressed, it seems unlikely, under current planning policy, that refusal of planning permission would be upheld provided need was demonstrated and appropriate attention given to siting and design.

2.2.3 Value for Money

The inability to draw on detailed evidence from deployment of this technology, even in a more rudimentary application, anywhere else in the world was concerning. As too was the apparent lack of demonstrated enthusiasm by the well-established manufacturers of high power electronic network equipment.

The Panel were concerned that the likely return from the OEM partners would not be adequate. The learning for these OEM participants would be largely funded by GB consumers whilst GB would benefit from only a limited number of applications.

Finally, as noted above, there may be local community concerns associated with the necessary planning applications. Achieving planning consent for the 8 out of 23 potential sites is necessary for break-even, and the Panel doubts whether a small number of applications spread thinly across GB is going to enable a wide and deep learning experience.

2.2.4 New Learning

The new learning from the first GB deployment of the HARP UPFC is anticipated to cover the following:

- Provide knowledge of UPFC deployment and its effectiveness on the GB distribution network and the impact of such use at the interface with the transmission network;
- Provide real-world data for future development and manufacture of UPFCs which should result in lower construction costs and lower deployment risk; and
- Development of network models, specifications, policies and implementation guides for the future deployment of UPFCs on GB distribution network.

The Panel is only partially convinced of this new learning given no direct involvement with other DNOs or, more importantly, with the GBSO.

2.2.5 Innovation

There are three distinct innovations or innovative outcomes associated with the HARP project:

- The use of a UPFC on the GB sub-transmission would reduce bottlenecks and allow effective congestion management at the 275kV and 400kV network interfaces. To date there have been limited examples of such UPFC deployment world-wide; a total of six have been are noted in the US, Korea and the China at the 154kV and 220kV levels. This different and low level of deployment makes its wider deployment in GB higher risk, and so limiting its use as BAU over traditional reinforcement measures;
- The control functions and software needed to make full use of the capabilities of a UPFC are deemed to be immature and so act as a barrier to wider uptake;
- There are no policies in place and no readily available tools to assess their use as an alternative to conventional solutions thereby impeding use as BAU.

2.2.6 Involvement of other Partners

WPD selected Mott MacDonald (MM) to lead the project given their extensive experience in power electronic solutions. MM will be responsible for managing the projects and for running the open competition to select the final UPFC manufacturer.

Given the potential for the sale of reactive power services, the Panel found it disappointing that the GBSO has only recently formally indicated an interest in the proposal and is not a formal partner. The UPFC offers benefits beyond simpler devices such as Quadrature Boosters, in

particular its speed of response to transient disturbances on the network, but it was unclear how the project would address and test the need for this, nor how its value could be monetised, especially in the absence of the GBSO as a formal partner.

2.2.7 Relevance and Timing

There is growing interest in the benefits of deploying power electronics onto the GB network. Unfortunately, the limited evidence offered in support of a wide spread use of the UPFC across the GB network added to the Panel's concerns with this proposal; this does not appear to be a solution that would be chosen or needed by DNOs with other, more cost-effective ones being more likely to deliver the benefits proposed.

Even if the capital costs could be reduced, without wide spread deployment, DNOs may also feel less inclined to choose it as a solution given the use of a relatively small number of installations of what is very advanced equipment would pose challenges to the DNOs in terms of training, spares and on-going support.

2.2.8 Robustness of Methodology

There are a number of factors that concerned the Panel:

- The cost to manufacture the UPFC is a key component in achieving the 2050 NPV of c£40 million. Securing an OEM partner to build the trial UPFC for no more than £12.7 million per site is vital. Although some indications of interest have been received, the project team have also inserted a Stage Gate which would stop the trial in the event that a suitable, cost effective OEM partner has not been secured (see VFM section);
- Planning approval for trial sites, and ultimately for full BAU roll out is unlikely to be trivial especially given the more marginal nature of the NPV benefits. The Panel were pleased that the land purchase for the trial would not be committed prior to selection of the OEM partner;
- Without a UK based OEM option, it is not obvious what level of the wider manufacturing benefits would accrue to the UK economy. The Panel would hope the contract for manufacture could include local manufacturing clauses consistent with EU procurement

although there is likely to be limited scope given the importance of the capital costs to the overall achievement of the benefits case.

2.2.9 Conclusion

The potential for more active management of the network to make best use of circuit capacity is increasingly attractive given growing emerging technological solutions. Whilst HARP may be a just such a power electronics option, the Panel is not convinced of its value for money for customers.

- It is a relatively high cost and offers a low benefits solution for the GB network;
- There is no certainty of a fair allocation of the potential rewards due to the lack of an OEM partner actively involved at this stage of the ENIC process;
- Finally, the lack of certainty around the potential number of deployment opportunities existing on the GB network added to the Panel's concern about VFM.

The Panel is therefore not recommending 2017 ENIC funding for the HARP proposal.

2.3 LV ENGINE

2.3.1 The Proposed Project

LV ENGINE	
Licensee	SP Manweb supported by SP Distribution - partnered with UK Power Networks (UKPN)
Total Project Cost	£8.30 million
NIC Requested	£7.29 million

The use of low carbon technologies (LCTs), which include solar panels (PV), electric vehicles (EV) and heat pumps, is expected to add up to 15 GW of PV generation and a similar capacity of EV and heat pump load to the GB LV network by 2040. Such a large capacity of LCTs connected to the LV network will lead to overloading and the voltage supplied to customers being out of limits.

The conventional solution is to increase the size the 11kV/400V transformers and/or LV cables at considerable expense and disruption. The alternative proposed is to exchange the current passive transformers with solid-state (power electronic) transformers to give a similar voltage transformation but with the ability to provide active control of power flows in meshed networks, and also of the three separate LV phase voltages. Active control of the LV network voltage would allow circuits to be operated in parallel and the voltage of individual phases adjusted dynamically. This more flexible operation of the LV circuits would permit increased connection of low carbon technologies and improved power quality to customers.

The project is to develop and deploy solid-state transformers (SSTs) on sections of the LV network. Five 11kV/400V, 500 kVA units would be built and deployed. Solid-state transformers have not previously been installed on public distribution networks although similar power electronic technology has been used on ships and for traction.

The units would also provide a direct current supply, which could be used, for example, to power street lighting circuits or commercial buildings. Important emerging DC loads include supplies to data centres and EV charging points in public car parks. The use of direct current in commercial buildings, e.g. to power office computers and desk lamps, has been proposed for some years and some early trials undertaken. It is argued that the use of a direct current supply can reduce the number of stages of voltage transformation and hence losses, as well as improving power quality. There is a growing interest internationally in the use of DC for power distribution and work is already underway to develop standards, including those that would be required to ensure effective protection and safety, were it to be deployed widely in place of existing AC distribution networks. The project would help to inform GB's input to this work.

2.3.2 Financial, Carbon and Capacity Benefits

The application of the SST solution within the distribution network at secondary substations (11kV/400V) would delay the need for more extensive and time-consuming upgrades of the local network, including replacement of conventional transformers and underground cables.

Financial benefits

The financial benefits from the GB roll out of the LV Engine solution is projected to be substantial, at £528m by 2050 and over £60 million by 2030.
The key assumptions used to generate these benefits are:

- The capital costs differentials are substantial with an SSTs solution set to cost £50k compared to the conventional transformer cost of £150k;
- Operating costs are however, more expensive at £701 compared to conventional of £74 per annum, reflecting the losses of the power electronics;
- By 2050 there are an estimated 36,000 individual deployments possible within the GB's network, or 16% of the total GB GMTs;
- The breakeven is stated to occur within 7 years of project start.

Although there is an LVDC trial proposed, no benefits have been assumed to accrue to the project from the successful roll out of these trial findings.

Carbon and Capacity Benefits

The capacity created by LV Engine would be no greater than that achievable through conventional reinforcement but may be created more quickly; the applicants believe an LV Engine solution can be delivered 15-18 weeks sooner than a conventional one. Speedier delivery of new capacity would no doubt be welcomed by potential new generators and we can expect that, in many instances, these would be providers of low-carbon generation. So, although the level of this benefit (earlier displacement of generation from sources that emit carbon) would not be significant, LV Engine could be welcomed as one of a suite of measures that increase low-carbon generators' confidence in the ability of the network to accommodate them.

With LV Engine, this capacity can be created while incurring a lower net carbon cost than conventional reinforcement. This is because the civil works required for conventional reinforcement would be avoided and this carbon saving would outweigh the effect of increased losses from the SSTs and from the network when SSTs are deployed. The applicants also expect

the losses from SSTs to reduce as their design improves; if this expectation were fulfilled the carbon cost difference would be enhanced.

There are potential carbon benefits arising from wider use of DC supplies. These range from reduced losses in AC-DC conversion and avoided AC cable replacement, through to the "snowball" effect of encouraging more DC-based technologies. The Panel note that LV Engine should contribute to the challenge of establishing what, in practice, can be achieved given the issues (noted above and below) associated with DC provision.

2.3.3 Value for Money

There do not appear to be substantial consumer issues with the SST although the introduction of DC supplies will require careful public and professional engagement.

There do not appear to be significant value for money concerns; there are likely to be many potential suppliers thus helping to ensure the capital and operating costs are competitive. Also it was encouraging to hear of the complementary nature of the LV Engine and Active Response projects which should further improve value for money.

Finally, the funding provided by project promoter and partners is in excess of the NIC minimum contribution; an additional £54k.

2.3.4 New Learning

The new learning from these SSTs trials are anticipated to cover the following:

- Provide robust functional specifications and control strategies for deploying the smart functionalities which are possible within an SST;
- Provide technical guidance, policy documents, a CBA methodology and tools to enable network planners to select , where appropriate, SSTs for future secondary transformers;
- Provide the functional specifications of fit-for-purpose network design to inform the provision of LVDC supplies to UK electricity customers from SST including the establishment of regulations and standards and provide recommendations to ESQCR and D-Code to make them fit-for-purpose for LVDC DNO supplies;

- Demonstrate the protection of LV networks where power electronics are used.

2.3.5 Innovation

There are three key innovative features in this SST proposal:

- To date no SST has been deployed on a distribution system in the GB and possibly also world-wide;
- No such device is presently available as a proven product from any manufacturer and it is anticipated that the trial will take the current TRL of SSTs from 5 to 8.
- Testing of LVDC on a DNO network adjacent to existing AC systems, and proving of the protection and standards required to make this practical and safe.

2.3.6 Involvement of other Partners

There are a number of partnering arrangements which reinforce the strength of this proposal:

- SPM will lead the project with support from UKPN. Through this arrangement there are effectively 5 GB licence holders involved which should increase the speed and certainty of any subsequent GB roll out programme;
- There is commitment from Glasgow City Council as partner in the LVDC trial;
- There is interest from key standards authorities in both the UK and EU namely, the International Electrotechnical Commission (IEC), and the BSI;
- Assistance in ensuring wider dissemination of the results has been supported by the Institute of Engineering and Technology;
- Finally, a supplier who will develop the solid state transformer equipment will be identified through a tendering process early in the project.

2.3.7 Relevance and Timing

SPM argue that the cost, performance and reliability of power electronics has improved to the point where solid state technology is now a feasible solution for the strain in the network caused by the increasing uptake of LCT and for deployment in the distribution network.

2.3.8 Robustness of Methodology

The lack of a suitable metering arrangement to allow effective testing of the LVDC trial was a weakness although discussions with ELEXON suggest this is not now likely to prove insurmountable.

Relevant standards and publications that will inform the LVDC network design and specifications have been identified which enhances the robustness of the underlying project methodology.

2.3.9 Conclusion

The Panel was convinced of the potential benefits that could accrue to customers from the successful deployment of the LV Engine solutions.

It was also reassured that the likelihood of wide dissemination as a BAU option was greatly enhanced by the collaboration of two DNOs who, between them, administer five GB licence areas.

Finally the strength of the proposal and methodological approach was clearly evident by the combined team who lead the bilateral meetings.

The Panel is therefore recommending 2017 ENIC funding for the LV Engine proposal.

2.4 ACTIVE RESPONSE

2.4.1 The Proposed Project

ACTIVE RESPONSE	
Licensee	London Power Networks (LPN) - in partnership with Scottish Power Energy Networks (SPEN)
Total Project Cost	£18.30 million
NIC Requested	£13.84 million

Distribution networks are experiencing a rapid uptake of low carbon technologies, particularly electric vehicles, and so can be expected to require reinforcement earlier than might have been expected. The requirement for these reinforcements can be postponed and in some cases eliminated through flexible control of the 11kV and 400V networks by a combination of active network management and power flow control using power electronics.

The Active Response project is in 2 parts:

- Network Optimise (NO)
- Primary Connect (PC)

It will develop active network management on the 11 kV and LV networks through a new system of advanced automation and optimisation. A new network optimization control system will be developed and deployed on the section of network previously instrumented and used for another project, “Smart Urban LV Network”.

The project will also develop, implement and demonstrate power electronic Soft Open Points (SOPs) at LV and Soft Power Bridges (SPBs) at 11 kV. Soft Open Points allow 400 V circuits fed from different power sources to be connected and the flow between them controlled. Soft Power Bridges fulfil a similar purpose at 11 kV but with slightly less functionality to control flow. Ten 400V SOPs and 200 LV circuit breakers and 100 link box switches will be deployed and two 11kV SPBs will be installed and tested.

2.4.2 Financial, Carbon and Capacity Benefits

The counterfactual for Active Response assumes traditional feeder installation cables are avoided for the Network Optimise cases and delayed by 13 years for the Primary Connect cases. The counterfactual also includes an increasing amount of Demand Side Response (DSR) as a means of delaying traditional reinforcement investment.

Financial benefits

The financial benefits from the GB roll out of the two options under the Active Response proposal are substantial. The Network Optimise proposal is projected to deliver benefits of around £325 million (NPV terms) whilst the Primary Connect proposal is projected to deliver £397 million (NPV terms) by 2050.

The key assumptions used to generate these benefits are:

- The capital cost differentials between the basecase and method are substantial:
  - NO: the Basecase average capex is £315k whereas the Method case average capex is £102k
  - PC: the Basecase average capex is £4.1 million whereas the Method case average capex is £396k
- The Basecase NPV analysis assumes there will be 3,301 uses of the NO solution and 820 PC deployments by 2050;
- The breakeven is projected to occur in 2022/23 and requires the installation of only 12 Network Optimise cases or 3 Primary Connect installations. So, even if the capital costs saving prove to be lower, there would still be adequate net benefits accruing given the potential deployment levels across the GB network.

Carbon and Capacity Benefits

The capacity released as a result of this project would be no greater than that achievable through conventional reinforcement but could be created more quickly. Since we can expect that this capacity would be taken up the application of low carbon technologies, there should be some carbon benefit through the earlier displacement of generation or loads that emit

carbon. The proposal should also provide stimulus and/or encouragement to low-carbon technologies by increasing the providers' confidence in the ability of the network to accommodate them.

Network Optimise offers a means of creating this capacity on the network at a lower carbon cost than conventional reinforcement; the installation of cable is avoided while the carbon cost of the remaining equipment is expected to be the same as in the conventional approach. Because Primary Connect is assumed only to defer reinforcement, it would(over the timescale being proposed) incur a higher carbon cost. In combination, the carbon cost would be lower than conventional approaches; the differential could be further improved if in the case of Primary Connect reinforcement was permanently deferred (which is possible) and/or the carbon cost of the silicon carbide element was improved as manufacture is scaled up (which is expected).

The trialling of silicon carbide in the SOPs as an alternative to silicon switches offers the possibility of environmental benefit to local communities through avoidance of noise disturbance which has been associated with the standard silicon devices.

2.4.3 Value for Money

The funding provided by LPN and partners is in excess of the NIC minimum contribution; an additional £2.562m or 24% of the total cost. Partners have reduced day rates. This is a technical project with few or no consumer issues. There do not appear to be value for money concerns.

2.4.4 New Learning

The new learning from the Active Response proposal is anticipated to:

- increase the DNOs' understanding of the issues relating to the prioritisation of automated control actions when using 3rd party provided network services;
- enable the development of algorithms that will be required to forecast and optimise complex networks at both HV & LV in close real time;
- assess the potential for the use of silicon carbide in the development of new, improved semiconductor technology in power electronics.

2.4.5 Innovation

There are two main innovative aspects to this proposal. First, the design of the SOP using silicon carbide is anticipated to take the technology to TRL 8 by the end of the trial. This would then offer significant performance improvements over equivalent devices used in earlier smart grid projects. Silicon carbide power electronic devices have the important advantages in congested urban settings of low losses and hence heat generation as well as operating above the human audible frequency range.

Secondly, the optimization part of the proposal tackles the complex challenge of optimizing multi-point or interconnected networks whereas, in the past, real-time optimization has generally been limited to simpler point-to-point applications.

2.4.6 Involvement of other Partners

The project will be undertaken by LPN with project partners: SPEN, Ricardo Energy and Environment, Turbo Power Systems (TPS), CGI.

- Including SPEN as design partner (who is also making a cash contribution to the project of £53k), the potential for swift GB rollout is greatly enhanced (between them, UKPN and SPEN hold 5 GB distribution licences);
- TPS is contributing £808k in cash and offers directly relevant experience in the delivery of power converters for use on the public LV distribution networks through their role with FUN-LV;
- CGI is contributing £260k and brings directly relevant technical know-how from FUN-LV;
- Ricardo is contributing £153k and will use NIC project knowledge in their technical and project management roles.

2.4.7 Relevance and Timing

The need for greater and increased levels of flexibility in the system to accommodate the anticipated growth in the use of LCTs and of increased DG availability adds to the attractiveness of real-time power flow management over traditional, and potentially more expensive reinforcement investment.

Taking the technologies that have been partially trialled in earlier NIC projects to TRL 8 enhances their potential to be rolled-out as BAU options across the distribution networks.

2.4.8 Robustness of Methodology

The Panel was impressed by the integrated nature of the project team; blending both strong technical skills with a sound understanding of the role of each member. It was also clear the project proposal and team is building on the learning from previous NIC projects, particularly in respect of the SOP which is building on the FUN LV learning.

The development of the advanced automation and optimisation system is the area of greatest uncertainty but which is also anticipated to offer the greatest project learning. In particular, the Panel are mindful of the non-trivial challenges the project team will face in developing robust State Estimation and acquiring Real Time Power Flow data which are essential for meaningful forecasting results.

2.4.9 Conclusion

This proposal offers DNOs timely and cost effective applications to help increase the network capacity. There is also a significant number of potential deployments possible thus helping to secure the net benefits potential across the GB network.

The collaboration between 2 DNOs adds to the Panel's belief that successful trialling of the Active Response proposals will increase their deployment as BAU and add to the cost effective solutions for RIIO-ED2 business planning.

The Panel is therefore recommending 2017 ENIC funding for the ACTIVE RESPONSE proposal.

2.5 DSO PROPOSALS

The Panel received three proposals, that met the criteria of the ENIC fund, that all aim to address the DNO/DSO transition challenge.

There is an increasing acceptance[1] that a low cost, low carbon power system of the future will require greater flexibility and co-ordination of loads and generation within distribution networks and between distribution and transmission systems. One approach to obtaining such flexibility is by evolving from passive distribution network operation, which is the norm today, and often becomes constrained as generation and demand needs exceed network capacity, to interactive and adaptive distribution system operation, where generation, demand and the network itself are optimised to minimise constraints, the so-called 'DNO/DSO transition'.

DSOs will assume the role of facilitating the management of supply and demand within the distribution system as well supporting the provision of ancillary services to the transmission system operator. Some of the immediate challenges facing distribution networks are to find ways to manage the charging of electric vehicles, the use of battery energy storage and the continuing increase in photovoltaic to maximise benefit to the entire electric power system and hence customers. This is a role DNOs currently perform albeit without a mechanism that optimised and balances the system in an open, fair and transparent manner for all stakeholders.

Clarity around the detailed functions of a DSO has yet to be determined and is the subject of debate and assessment by the industry, led by the ENA Open Networks Project. To aid this definition work, DNOs the GBSO and Ofgem need greater clarity on what will or could work and, just as important, what needs to change within the current system to ensure a smooth transition is achieved.

Two of the three DSO proposals (EFFS and TRANSITION) directly support and build on the ENA Open Networks Project while the third (FUSION) aims to demonstrate a solution to a known constraint in the licensee's area, through trialling an alternative market structure that is presently being demonstrated elsewhere in Europe.

[1] Upgrading our energy system, Smart Systems and Flexibility Plan, BEIS and Ofgem, July 2017

In particular:

- FUSION is aiming to test the lessons to be learned from applying a neutral market facilitator framework embodied in the USEF rules and, in doing so, outline what amendments and developments would be required for this framework to be of use in a GB-wide context;
- EFFS is aiming to determine the data standards and requirements and IT needs to enable a more timely forecasting and optimisation arrangement on the network;
- TRANSITION is trialling the development of a scalable and enduring solution to the DSO challenge, building on the ENA Open Networks Project Work Stream 3 outputs whilst also collaborating and learning from the lessons gained from both EFFS and FUSION.

Given the commonality of the Financial, Carbon and Capacity benefits and their Relevance and Timing, these two elements of the Panel's review of the three DSO proposals are dealt with in the following section. In addition, there are general Governance and Methodological issues that need to be addressed in addition to doing so at the project specific level.

2.5.1 Financial, Carbon and Capacity Benefits

Financial Benefits

Studies supported by Ofgem, BEIS and the Industry estimate the benefits for GB customers of a smart energy system, to 2050, could amount to £17-40bn. Each of the three ENIC proposals (i.e., FUSION, TRANSITION and EFFS) project that the development of a GB-wide DSO open market arrangement would yield benefits of between £250 million and £300 million, in NPV terms by 2050.

Whilst there is inevitable uncertainty as to the final quantum of such benefits, there is sufficient evidence that they are likely to be both large and enduring if the model developed is robust.

Carbon and Capacity Benefits

All three proposals offer the opportunity to create flexible capacity on the network while deferring or avoiding conventional reinforcement. In some instances, " bilateral" agreements

and/or “flexible” connections might be considered the more appropriate counterfactual; here market-based approaches are likely to be advantageous by providing capacity that is more flexible, opportunities for a wider range of participants and visibility for all stakeholders.

Ultimately, the amount of capacity to be created will depend on the market response. The uncertainty inherent in forecasting this, together with project-specific factors and methodological differences, is illustrated in the applicants’ own forecasts of capacity provision which range from 0.6 to 5.4 GW capacity GB-wide by 2050. A better understanding (and hence improved forecasts) of the potential of GB-wide open market arrangement(s) to deliver capacity more effectively than current arrangements is an expected outcome of each of the proposals.

Likewise, considerable uncertainty is associated with any attempt to estimate the carbon benefits of these proposals. The uncertainty associated with forecasting the capacity changes is compounded by that of forecasting the nature of the market trades that might occur; demand-side responses and the connection of low-carbon sources of generation will generate a carbon benefit while the uptake of capacity by existing fossil fuel generators will not. Again, the deliverables of each project should include the prospect of better estimates of potential carbon benefits.

2.5.2 Relevance and Timing

The need for increased co-ordination of the distribution and transmission networks is well understood. In preparation for RIIO-ED2, the DNOs are expected to submit business plans. For customers to benefit from innovative cost-savings, these plans should, where possible, incorporate market-based solutions that release network capacity more cheaply than traditional reinforcement. The DNOs will therefore be expected to make maximum use of solutions that are reliant on having DSO capabilities in place.

To ensure RIIO-ED2 fully reflects the DNO investment intentions with a fully functioning DSO market-based solution, the ENA Open Networks Project has suggested a timeline illustrating what needs to be delivered over the next 2-5 years. For example, by the start of RIIO-ED2 in 2023, it is assumed there will be a commercial platform that is scaled for GB ensuring full

GBSO-DSO interfaces[2]. The ENA Open Networks Project also signals the need for learning from prototypes and trials to be feeding in to the industry from 2017-18 to ensure this 2023 deadline is achieved.

The need for network forecasting tools, DSO interface prototypes, flexibility products, commercial platforms and an understanding of the regulatory frameworks and policy changes that will be required all feature in the ENA Open Networks Project's menu of needed activities to 2023. The ENIC proposals offer the potential for some of this learning to be achieved and so all three fit the timescale signalled by the industry.

It might be argued that the three schemes being submitted for the ENIC 2017 funding are premature given the ENA Open Networks Project Work Stream 3 has not yet provided clarity on which of the market models are deemed relevant for trialling. The Panel took the view that although absolute clarity from ENA Open Networks Project would have been desirable, there was sufficient evidence in the proposals to merit the Panel's full consideration and assessment which is provided in the project specific sections below.

2.5.3 Value for Money

Together, the three DSO proposals are seeking ENIC funding of £21.32 million (roughly one third of the total 2017 ENIC bids of all seven proposals). It may be possible to argue that ideally only one co-ordinated proposal should have been made by all DNOs. On the other hand, developing such a proposal might have excluded, prematurely, options which deserve exploration in a trial. Under-spent NIA support may have been an alternative means of funding this innovation research. It is accepted, however, that the use of NIA funding may not be totally relevant given the wider GB interest required in the proposed trials.

The Panel can only assess what has been submitted. However, following the bilateral meetings all three project promoters agreed to undertake an extensive assessment of where potential for further VFM for customers would be possible (see below). Indeed, one, namely FUSION, has already factored in to their bid cost savings of around £1.5 million which are believed to be possible. More importantly, they all expressed a wish to ensure the research work complements the output of the ENA Open Networks Project.

[2] See, 'Open Networks Project – DSO Transition: Roadmap to 2030'

Finally, the development of three complementary, smaller projects may offer added learning sooner and with potentially less delivery risk.

2.5.4 Robustness of Methodology

The Panel has assessed this criterion for each of the DSO proposals and is comfortable with the proposed project outputs. However, optimisation of how and when these are to be delivered through the collaborative approach offered by all three projects at the bilateral meetings requires greater clarity.

In particular, within the first six months of receiving formal ENIC approval all three project sponsors stated they would undertake a review that includes the following:

- Define the scope of works to identify and resolve potential areas of duplication between the three projects;
- Undertake a detailed definition of requirements to decide on the use of complementary market models;
- Consult on proposed activities so that the work is coordinated and aligned to ensure customers are informed on a "holistic" basis;
- Outline detailed trial definitions and agree high level trial requirements including, *inter alia*, the development of relevant Stage Gates as a means of formally testing the continued validity of the proposed trials;
- Ensure the dissemination activities are coordinated so that stakeholders are informed in a coordinated fashion;
- Agree suitable Stage Gates to align the phasing of the projects such that all three have concluded the Design Stage prior to moving to deployment;
- Define cooperation activities identifying how projects will interact, how peer review of outputs will work, who will be attending project meetings, and how the various work packages will align and complement the Open Networks Project's activities.

The Panel feels this Review is essential to ensure there are no unnecessary overlaps and duplication of effort as a means of safeguarding customers' funds and ensuring they are used efficiently and effectively.

2.5.5 Conditions of Panel Recommendation

The Panel's recommendations are conditional on the full implementation of such a Review being binding and involving the input and agreement of all DNOs and following full consultation with the ENA Open Networks Project stakeholder groups.

Significant comfort has been taken from the statement made by all three project proposers at the bilateral meetings that the governance arrangements underpinning each individual project will be driven by the outputs of the ENA Open Networks Projects through formal collaboration with Work Stream 3.

However, for the avoidance of doubt, the Panel recommends that NIC funding is only released on the following basis:

- Within 6 months of a Project Direction being issued, the three projects will formally report their coordinated Review findings to the ENA Open Networks Project Steering Committee;
- The ENA Open Networks Project Steering Committee formally approves the resultant work programme;
- Ofgem formally approves the individual funding allocations.

2.6 TRANSITION

2.6.1 The Proposed Project

TRANSITION	
Licensee	Southern Electric Power Distribution (SEPD) - partnered with Electricity North West Limited (ENWL)
Total Project Cost	£14.70 million
NIC Requested	£13.08 million

The project is to support the transition of DNOs to DSOs and identify suitable markets and software platforms. It will result in trialling a platform to carry out live testing of the outputs of the ENA Open Networks project. WS3 of the ENA Open Networks project intends to define a number of market models but these have not yet been published. The project will demonstrate the concept of a Neutral Market Facilitator (NMF) and a suitable software system to allow its implementation. Trials of the Open Networks market models will be carried out in several locations, chosen to represent the GB system as a whole, including rural, rural and urban mix, and urban networks.

The project will be undertaken in two phases with a Stage Gate.

- Phase 1 will address the definition of requirements, stakeholder engagement and consultations, IT architecture and integration requirements. This phase will take 16 months at a cost of £2.8m. It is intended to complete Phase 1 by April 2019;
- Phase 2 will implement the ideas and systems developed in Phase 1 over 32 months by December 2021 at a cost of £11.9m.

The proposal is comprehensive and will address many of the aspects of the DNO/DSO transition including:

- market structures (including bilateral agreements) or market models;
- frameworks describing the rules for the markets and transactions;
- platforms for carrying out the transactions including capturing the contracts,

- communicating the transactions to all affected parties and verifying that the contract has been fulfilled.

Within 6 months of the inception of the project a formal collaboration will be established with any other project addressing the DNO/DSO transition funded under the ENIC and the resultant Review will deliver what is outlined in para 2.5.4 above.

2.6.2 Financial, Carbon and Capacity Benefits

Refer to separate section under DSO proposals 2.5.1.

2.6.3 Value for Money

If evaluated in isolation the Panel feels TRANSITION is delivering VFM due to the use of a Stage Gate. Comfort around VFM is reinforced from the evident sense of collaboration, under the auspices of the Open Networks Group, which each of the DSO projects displayed at the second bilateral.

In the initial stages of the project, consumer engagement will not be an issue, but will become so when market models come to be tested in practice. The governance arrangements proposed appear to be robust in this respect.

2.6.4 New Learning

The new learning from Transition includes:

- Identifying the data and exchanges requirements for the DSO model and map these against existing capabilities;
- Test and validate the market model options being trialled;
- Establish system processing and visualisation requirements, including data protection and information security (including cyber security risks).

2.6.5 Innovation

The architecture needed to facilitate an effective, open and neutral market for flexibility services and to ensure efficient use by the DNO and SO, of DG and DER has yet to be developed or trialled for the GB network. This project will offer important insights in the data requirements, and market mechanisms required to allow its roll out in a managed and timely manner.

2.6.6 Involvement of other Partners

There are a number of key partners in this proposal:

- The collaboration between SSEN/SEPD and ENWL will add to the understanding and knowledge transfer of the GB DNOs and so aid the eventual GB roll out;
- CGI have been involved in previous, relevant IT platform developments such as that developed for MOSL in the opening up to competition in the English water market;
- Atkins will provide consultancy support for project development, systems modelling and technology implementation;
- Northern Powergrid and Origami will offer insights into the needs and role of aggregators;
- GBSO are not a formal partner albeit their input will be critical in the development of any DSO proposal. Evidence of their knowledge of the Transition proposal was provided late in the review process.

2.6.7 Relevance and Timing

Refer to separate section under DSO proposals 2.5.2.

2.6.8 Robustness of Methodology

The development of the work packages and timescale is aimed at being fully compliant with and led by the outputs and timeline from the ENA Open Networks Project. This means the proposal has a formal Stage Gate to ensure the details of the Work Packages 7-9 fully comply with the ENA Open Networks expectations.

The collaboration Review with FUSION and EFFS will ensure the sequencing of the development of the TRANSITION work packages offers a robust methodology whilst continuing to ensure the original outputs remain to be delivered.

2.6.9 Conclusion

Trialling DSO market arrangements that reflect the options identified by ENA Open Networks, is the key deliverable from TRANSITION. The benefit of linking with EFFS and FUSION reinforces the Panel's view that the learning from TRANSITION will be both unique and complementary. The Panel is supportive of the general approach proposed by TRANSITION.

It is also pleased to note the collaborative approach TRANSITION has indicated it will follow to ensure work packages included in FUSION and EFFS (and vice versa) are not repeated in the development of the TRANSITION trials.

Subject to the conditions outlined in paras 2.5.4.and 2.5.5 above, the Panel is recommending 2017 ENIC finding for the TRANSITION proposal.

2.7 FUSION

2.7.1 The Proposed Project

FUSION	
Licensee	Scottish Power Distribution (SPD)
Total Project Cost	£5.97 million
NIC Requested	£5.29 million

This proposal will demonstrate a smart electricity market framework using the flexibility of network customers. It will use the Universal Smart Energy Framework (USEF) developed by a European organization, the USEF Foundation, and investigate its costs and benefits and how it can be used in the GB environment. Flexibility will be procured through a local competitive, open and structured market. The approach will recognize the value of flexibility to distribution

networks as well as to generation and transmission ancillary services e.g. frequency control, and will define a set of standard flexibility "products" that can be traded.

The demonstration area is East Fife where 4 examples of the mitigation of constraints through flexible operation will be investigated and demonstrated using Demand Side Response and Distributed Generation turn-up. The case studies address the following constraints:

1. Overloaded 33kV circuit;
2. Insufficient capacity of a 33/11kV substation;
3. Insufficient capacity on an 11 kV circuit;
4. Insufficient capacity of an 11/0.4 kV substation.

The project will be undertaken by SPD with project partners*:* Fife Council, University of St Andrews, Bright Green Hydrogen Ltd, SAC Consulting Ltd, Imperial College London, Origami Energy Ltd, Passiv Systems Ltd, and DNV GL Ltd. It will demonstrate the proof of concept and the use of the USEF to provide commoditized flexibility.

A unique feature of this project is that it will adapt the market rules and arrangements that have been developed within the USEF to ensure they are suitable for use within the commercial and technical structures of the GB power system. It is argued that by building on the work already undertaken by the USEF and trialling the market arrangements in the well-instrumented East Fife area that rapid progress can be made and the undoubted challenges of building a DSO system based on open markets identified.

2.7.2 Financial, Carbon and Capacity Benefits

Refer to separate section under DSO proposals 2.5.1.

A feature of FUSION not found in the other two proposals is the involvement of an aggregator. It may be argued that this is of particular benefit to providers of low-carbon services who may otherwise struggle to participate in the market due to size, lack of expertise or resource, or other factors.

2.7.3 Value for Money

The selection of this proposal was the result of a competition for demand side response solutions from 3rd party providers with FUSION being chosen from 35 submissions based on the application of 6 selection criteria one of which was VFM for the customer.

Comfort around value for money can also be gained from the evident sense of collaboration, under the auspices of the Open Networks Group, which each of the projects displayed at the second bilateral meeting. FUSION reduced its costs from £6.9m to £5.3m in its re-submission through partner contributions and synergy opportunities with the other two projects. Detail of this is needed to demonstrate whether stakeholders, notably St Andrews University, are making a reasonable financial contribution. Of the three projects, FUSION is the one closest to implementation in the market, and therefore has the most need to demonstrate early evidence of strong consumer engagement. The project governance structure presented appears to be substantial in this respect.

2.7.4 New Learning

The new learning from FUSION includes:

- How to establish and sustain a local flexibility market within the existing regulatory framework;
- Seek to test the implementation of a neutral market facilitator based on an augmented set of USEF-based rules and market framework;
- How the role of Aggregator might work as an alternative to a DNO led market solution.

2.7.5 Innovation

The USEF framework offers the potential for the fast deployment of a fully functioning platform. Such a requirement is an essential element of the DSO market model whichever market solution(s) are finally chosen. The FUSION trial will offer the means of developing a set of rules and protocols that would work in the GB environment.

2.7.6 Involvement of other Partners

There are several key partners who will be involved in the FUSION proposal:

- DNV GL Ltd is a critical partner being a founding partner in the USEF Foundation. They will be responsible for the due diligence work in assessing the implementation of the USEF framework in the GB market;
- Passive Systems and Origami Energy will be providing aggregator input for I&C and domestic customers respectively;
- The University of St Andrews will be a major contributor of flexibility services (and have offered to provide such services for the duration of the pilot at nil cash cost);
- Collaboration of all market participants will become clear post the 6 month review of the 3 DSO projects.

2.7.7 Relevance and Timing

Refer to separate section under **DSO proposals 2.5.2.**

2.7.8 Robustness of Methodology

Whilst the Panel were not totally convinced that East Fife was wholly representative of the GB network, the fact that it is a well-understood and instrumented means that it offers an appropriate test-bed trial site for the FUSION proposal.

More of an issue is the lack of a firm role by the GBSO. Understanding how conflicts between DNO and SO can be managed within a commercial framework will be essential should the EN Open Networks propose a DSO model that is not strongly locally based. Under the USEF framework, this GBSO conflict issue is wholly or largely managed via aggregators and this is therefore a key aspect of the methodology being deployed.

2.7.9 Conclusion

Securing effective commercial rules as a means of providing financial signals and a commercial rules based approach to solving the DNO/TO conflicts is an essential requirement for the new

DSO world. Whilst the Panel accepts the USEF framework may not currently provide all that is required for the GB market, it firmly believes the learning for the FUSION trial will offer substantial insights into what will and will not be needed.

The Panel took comfort from the involvement of DNV GL Ltd given their proven experience of developing and deploying commercial frameworks elsewhere in Europe. It also believes the FUSION learning will benefit from the large amount of R&D expenditure already undertaken in the development of the USEF framework to date.

Finally, the Panel feels the choice of Fife is positive as it allows the timely implementation of the trials once the collaboration Review work has been completed and the project deliverable have been re-affirmed.

Subject to the terms outlined in paras 2.5.4 and 2.5.5 above, the Panel is recommending 2017 ENIC funding for the FUSION proposal.

2.8 ELECTRCITY FLEXIILITY AND FORECASTING SYSTEMD (EFFS)

2.8.1 The Proposed Project

ELECTRICITY FLEXIBILITY AND FORECASTING SYSTEMS (EFFS)	
Licensee	Western Power Distribution – East Midlands (WPD) - Lead by AMT Sybex
Total Project Cost	£4.31 million
NIC Requested	£2.94 million

The proposal is to develop a software and communication system to support the operation of a Distribution System Operator (DSO). The outputs of the project would support the ENA Open Networks Project by, defining the high-level functions a DSO must perform, providing a detailed specification of the new functions that are required and creating a specification for data exchange. A key output from the project would be a forecasting tool that would enable the DSO to identify the requirement at any given time for flexibility across the network, mainly on 132kV and 33kV substations and circuits, and over time horizons ranging from operational

(daily) to planning (years ahead). It is based on the expertise of AMT-Sybex in forecasting demand and the output of distributed generation, and their experience of managing battery storage. AMT-Sybex previously developed the battery control software for UKPN's Smarter Network Storage project.

The control system would optimise the manner in which demand and supply in distribution networks would be managed flexibly and conflicts with the needs of the TSO resolved. 4 Work Packages are proposed:

WP1 – Forecasting, coordination and requirements;
WP2 – System design, development and build;
WP3 – Testing trials and conflict management;
WS 4 – Collaboration and learning dissemination.

The least-cost operation of the combined distribution network, generation, load and storage requires forecasting and optimization by the DSO in a way that has not previously been needed for passive networks. Particular examples of the challenges that will be addressed in this project include forecasting the output of weather dependent distributed generation and optimising the operation of storage, which is constrained by both power flows and stored energy, within a large network.

2.8.2 Financial, Carbon and Capacity Benefits

Refer to separate section under DSO proposals 2.5.1.

2.8.3 Value for Money

WPD and AMT-Sybex are contributing more than the minimum 10% of project cost; £1.293m, or 30% of the total. Comfort around VFM can also be gained from the evident sense of collaboration, under the auspices of the Open Networks Project, which each of the DSO projects displayed at the second bilateral meeting.

2.8.4 New Learning

The new learning from EFFS is anticipated to be in a number of areas:

- Innovative demand forecasting methodology;
- Insights into DNO-DSO co-ordination and conflict avoidance strategies;
- Development of interface protocols to 3rd parties;
- Additional DSO systems requirements;
- Integration of a flexibility management system.

2.8.5 Innovation

The innovative aspects of EFFS revolve around the delivery of a functioning single software product or system within the market place that supports the delivery of the ENA Open Networks Project's 9 functionalities and systems requirements.

The algorithms, interfaces and design models that will be trialled are the key innovative aspects that are needed to support the proposed new market system.

The data provided from these trials are essential to fill the information gap needed to help build a robust business case for the adoption of the software and operational processes to deliver the chosen market solution.

2.8.6 Involvement of other Partners

There are 3 key partners involved in this trial:

- AMT-Sybex (who are making a cash contribution of £0.963k) are the software solutions provider and will configure the EFFS for the project;
- EDF Energy are partnering as an aggregator / supplier to the market system trialling;
- National Grid as the TSO will engage in conflict management and trial interface activity.

2.8.7 Relevance and Timing

Refer to separate section under **DSO proposals 2.5.2.**

2.8.8 Robustness of Methodology

The proposal's main challenges are (a) how to develop the demand forecasting tool and (b) how to ensure effective testing given the reliance on other key components such as the optimisation and pricing tools.

- The use of the AMT-Sybex Affinity Suite of products reduces the IT systems risks with the forecasting tool;
- The use of an academic partner for the forecasting work package should provide the necessary research rigour. The Panel took additional comfort from the role of Capita's Chief Data Scientist, who will act as Design Authority for this part of the work;
- The lessons from Cornwall LEM will offer valuable insights into the optimisation and market pricing modules, and the project also intends to demonstrate data exchange with the EDF market platform, to show how the standard interfaces can be adapted as required.

2.8.9 Conclusion

A key aspect of the DNO-DSO transition being developed for the GB network is a comprehensive, accurate and timely understanding of the various demand and supply options that will be available both to the DNO/DSO and the TSO for managing network constraints. The Panel is content that the EFFS proposal will provide significant insights into how such a forecasting and optimisation capability can be developed.

Subject to the conditions outlined in paras 2.5.4 and 2.5.5 above, the Panel is recommending 2017 ENIC funding for the EFFS proposal.

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:

3.1 RECOMMENDED FOR FUNDING

- LV Engine

  Licensee: SP Manweb (SPM)

  - partnered with UK Power Networks

  NIC requested: £7.29 million

- Active Response

  Licensee: London Power Networks (LPN)

  - partnered with Scottish Power Energy Networks (SPEN)

  NIC requested: £13.83 million

- TRANSITION

  Licensee: Southern Electric Power Distribution (SEPD)

  - partnered with Electricity North West Limited (ENWL)

  NIC requested: £13.082 million

- FUSION

  Licensee: SP Distribution (SPD)

  NIC requested: £5.29 million

- Electricity Flexibility & Forecasting System (EFFS)

  Licensee: Western Power Distribution – East Midlands (WPD)

  NIC requested: £2.94 million

3.2 UNABLE TO RECOMMEND FUNDING

- Power Saver Plus (PS+)

  Licensee: Electricity North West Limited (ENWL)

  NIC requested: £7.02 million

- Holistic Active & Reactive Power (HARP)

  Licensee: Western Power Distribution – East Midlands (WPD)

  - led by Mott McDonald

  NIC requested: £14.45 million

4 ADVICE FOR FUTURE COMPETITIONS

The purpose of this section is to provide feedback on particular points arising from this competition and to draw attention to a number of issues that Ofgem may wish to communicate to the companies, or to take account of when revising the Governance Document.

4.1 DNO Collaboration

Whilst the level of collaboration between DNOs in this year's ENIC round is notable, the Panel remains of the view that this type of arrangement should nonetheless increase. Even though the ENIC fund is a competitive one, collaboration around individual proposals remains key to Panel getting comfort that success will more likely result in swift BAU roll out.

4.2 Quality of submissions

Unfortunately, as has been the case in previous ENIC rounds, the Panel was faced with varying quality of bids. For the Panel to be able to fully support the proposals, it needs to be able to understand exactly what is being proposed, i.e., the challenge or problem being tackled and the proposed solution with supporting evidence. Indeed, in a number of cases, it took until the end of the 2nd bilateral session and follow-up answers for the Panel to fully understand what was being proposed.

The Panel would suggest the submissions also seek to use the sections headings that are used in the Expert Panel's Recommendations Report. This may also be something Ofgem should reflect on in the guidance.

There is a continued lack of clarity as to the nature and appropriateness of the counterfactual(s) being considered, which obscures key information concerning costs and benefits. The Panel suggests more attention is given to this issue and that more robust breakeven analysis is provided.

Finally, the discipline of the bilaterals is something the Panel wish to build upon and would suggest that Ofgem ask for the presentation that project sponsors will be using at their 1st bilateral session to be part of the full submission. This would act as an executive summary, without extending the work required by bid teams.

4.3 Senior management involvement

The Panel appreciates the involvement of senior management and believes it has added to merit to the bid process. Such involvement would help clarify the project objectives prior to them being submitted and would give reassurance the Panel on commitment for BAU roll out.

5 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 'newish' Expert Panel. Their technical and administrative input along with the technical support of the Consultants Jacobs ensured the Panel was able to undertake effective scrutiny of the ENIC proposals.