Review of Low Carbon Network Fund proposals

Report to Expert Panel

Western Power Distribution

WPDT2001: LV Network Templates

8th October 2010

Report prepared by TNEI and Arthur D. Little
for project commissioned by Ofgem

Report Context

This report has been prepared for the Expert Panel with the aim of supporting them in their funding allocation decisions for the Low Carbon Network Fund.

Having reviewed the submission pro-forma and all of the supporting material, as well as answers to clarification questions we have put to the DNO, this report is intended to serve two purposes:

- it sets out any factual clarifications that we believe would be helpful to the expert panel when considering the submissions, based on information or data that is not immediately apparent or available in the pro-forma or Appendices A-E; and
- it highlights any concerns we have in any particular areas from, for example, either a technical, commercial or deliverability perspective, that the Expert Panel may wish to explore further with the DNO.

Consequently, the Expert Panel can assume that the factual content of the submission pro-forma to be sound unless noted otherwise in this report.

In writing the report we have avoided merely reproducing large parts of the submission, which stands on its own merits for the Expert Panels' consideration.

This report does not seek to assess the quality of this submission or rank it against any others. In particular, it does not provide any opinion as to whether the proposal should be funded. This is the role of the Expert Panel.

This report is not intended to be read in isolation and should be reviewed alongside the pro-forma and compulsory appendices.

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Project: LV Network Templates

Description of Project (summarised from pro-forma Box 1)

Understanding Network Constraints

WPD is seeking to deploy system-monitoring equipment to characterise the behaviour of a wide range of low-voltage networks and also to track the impacts of deploying low carbon devices in up to 3,000 homes and businesses. This will help to optimise future monitoring, reinforcement and other network planning and operation issues for distribution networks.

Problem

The UK Low Carbon Transition Plan spells out the importance of a transition to a low-carbon economy. The part of the network that will be most affected by these necessary changes is the low-voltage (LV) network that supplies homes and businesses. The LV network is also the part of the network about which we have the least information about, or knowledge of the 'headroom' available to accommodate a low-carbon future. We do not accurately understand the impact of low-carbon initiatives on the LV network, and have little insight into the supply performance of the LV network against the European power quality standard EN50160. Therefore, we do not have a clear picture of how best to design or manage the network to meet these challenges. Nor can we tell National Grid how much UK LV micro-generation is running – having knowledge of this micro-generation will optimise the UK's spinning reserve.

Solution

The project will give WPD a view of the power flows and voltages of the LV network in South Wales, together with visibility of impacts arising from Welsh Assembly Government (WAG) low-carbon initiatives covering some 3,000 homes, and including 1,000 PVs installations. The project will compare non-stressed and stressed network locations, and thereby measure the impact of these low-carbon stresses. The project will also present National Grid with the 'hidden' generation available in the monitored areas, which will improve network efficiency. Bath University will create a number of reusable network templates composed of varying characteristics about the nature of the network. With the aid of these templates, DNOs across the country will understand the characteristics of the network and its capabilities to absorb low-carbon stresses.

Method

The solution will enable 'visibility' of the LV network by installing over 8,000 voltage sensors and associated communications at over 1,000 distribution substations and over 7,000 selected 'feeder end' points in the South Wales area, in order to provide accurate information to assess the impacts of low-carbon stresses on the network. The project will directly involve in excess of 7,300 customers, and feature a number of partners and local housing initiatives in South Wales; the span of the network involved in the study encompasses 10% of the South Wales population. These sites/customers have been selected because of their proximity to existing and future Welsh Assembly Government 'Arbed' sites, and npower's Community Energy Saving Programme (CESP) and Carbon Emissions Reduction Target (CERT) customers, in parallel with sites that don't have a quantity of low-carbon stresses. Critically, this project is being undertaken on an existing network – vital when we consider that the majority of low-carbon impacts will not be on new network build.

Project

The project consists of WPD, along with External Collaborators npower and Bath University. Partners, all situated in South Wales, include numerous microgeneration sites built as part of WAG's Arbed scheme, in addition to npower's customers. The project is 36 months long, with sensor deployment across a 9 month period, starting in April 2011. Data collection will commence immediately, and analysis of data commence in June 2011. Closedown of the project will be in July 2013.

Key Project Figures

Project

Funding requested:	**£7.85M**
Total Project value:	**£9.02M**
Direct Benefit:	**£0.022M**

Roll-out	**Proposal**
Total Carbon Benefit (discounted):	**£0.11B**
Total Other Benefits (discounted):	**£0.35B**
Total Costs :	**£6.6M**
Net Benefit :	**£0.46B**
Carbon Saved (undiscounted):	**5.0 million tonnes**

TOTAL WITHOUT CONTINGENCY	8,197,500
Percentages of total cost	
Contingency	10.0%
IT	1.3%
Equipment	64.7%
Staff	32%
Internal	*16%*
Contractors	*16%*
Payments to consumers	0%
Decommissioning	0.0%
Other	2%

EXPLICIT PROJECT MANAGEMENT LABOUR	
Project Working Days	660
Labour Days	3080
Full Time Equivalents	4.7
Project Management	£900,000
Relative to Project Cost	10%

		FUNDING PROPORTION OF TOTAL ITEM COSTS			
Key Items	**Total Cost**	**External**	**LCNF**	**DNO**	
				Compulsory	**Extra**
Labour	1,349,000	0%	90%	10%	0%
Equipment	5,301,050	0%	90%	10%	0%
Contractors	1,292,800	4%	86%	10%	0%
IT	106,450	0%	90%	10%	0%
IPR Costs	-	-	-	-	-
Travel & Expenses	-	-	-	-	-
Payments to users	-	-	-	-	-
Contingency	819,750	0%	90%	10%	0%
Decommissioning	-	-	-	-	-
Other	148,200	0%	90%	10%	0%
Total	9,017,250	1%	89%	10%	0%

Summary of independent analysis

General View:
The project focuses on network monitoring and modelling in areas with relatively high and low penetration levels of low carbon technologies with the view to developing robust LV network templates to aid the efficient and cost effective development of networks.

The project appears to be straight-forward to deliver provided that no customer resistance is met on the placement of equipment within their premises. The overall value of the information gathered is possibly limited as there is a risk of locational specific characteristics, and is the project is not going to result in any definite actions that will be physically tested on the networks.
(DNO comment: the customer profile class, equipment specifications, network design requirements & principals, and network design tools are the same as used by other DNOs. The concept of templates for national use has been put forward by ENA [Energy Networks Association])

Significant Issues:
The usefulness of the proposed LV template will be critically dependent on how the other DNOs view the selected WPD networks as sufficiently representative of GB in order to establish acceptable common templates.

Specific Issues:
- There are varying degrees of commercial dependence/exposure on the success of the project: the benefits to RWE npower depend on extent to which they are looking to develop low-carbon products and services

- There is no specific partner listed to ensure security/privacy of customer data

- Risks to timing have been identified – notably the availability of meter operators, cooperation at micro-generation sites, customer engagement, etc; however detailed assessment of impact/probability has not been included. These risks could affect deliverability of the project

- The carbon savings are modest as conservative assumptions have been made, such as a lifetime that does not extend beyond 2030 and very modest shifting of electricity due to PV penetration.

- We note that the net benefits are modest, partially due to pessimistic assumptions on benefit accrual (not reaching 100% of potential benefits until 2030), as well as the assumption that LV Templates are only applicable to 50% of GB networks

- The project is not explicitly deriving solutions for increased connection of low carbon technology onto networks but will help to inform the connection process through the identification of thermal and voltage headroom as well as network types that have greater capacity for connection of low carbon technologies.

- Some concern on the fact that the external dissemination is not until 06/2013 which is quite late in the project, particularly given the early availability of measurement information. It is noted that WPD have recognised the need to establish a full year of data for credible data analysis which pushes back the dissemination events (other than annual conference presentations).

1. Accelerates the development of a low carbon energy sector

Summary:
The project focuses on network monitoring and modelling of a spectrum of network types including some areas with relatively high penetration levels of low carbon technologies

The carbon savings are modest as conservative assumptions have been made, such as a lifetime that does not extend beyond 2030 and very modest shifting of electricity due to PV penetration.

1.1. The proposal is closely aligned to priorities outlined in the current Low Carbon Transition Plan	The focus of the study is on network monitoring and modelling, and includes areas which have considerable penetration of low carbon technologies, enabling comparison of network impacts to be undertaken. The resulting models and network design parameters should allow for greater connections of renewables in the future.
1.2. The calculations for carbon savings are robust (audit of calculations only)	The calculations for carbon savings appear robust.
1.3. The carbon benefits of the project are credible	The carbon benefits are credible, though we note that they are conservative as a pessimistic assumption is used that benefits only occur until 2030, when the IT infrastructure (e.g. smart meters) reaches the end of its technical life. Carbon benefits are based on the penetration of PV units consistent with the 2020 levels in the UK RE plan, and that there is no increased penetration beyond this level. The calculations also assume that only 25% of the 2,240 GWh of PV production displaces OCGT generation at 0.6 t CO_2/MWh. We note that this is higher than the DECC figure for 2010 for electricity overall, which is 0.4675 t CO_2/MWh. The carbon benefits are valued using DECC Traded Carbon Prices.
1.4. Extrapolation for roll-out is both statistically and technically sound, reliable and/or verifiable.	The extrapolations appear feasible.
1.5. Total energy system consideration as well as for DNO	There are no other specific assumptions on behalf of other system operators
1.6. Assessment of Method's credibility	The Method should allow other DNOs to better understand the impact of low carbon technologies on their networks and to introduce new planning and operational procedures to better accommodate them. We note the assumption that the templates will only cover 50% of the remaining GB networks.

1.7. Significance of the Deliverable	The project should deliver better load flow prediction models for LV networks.
Re-estimation of carbon benefits on the basis of "correcting for erroneous assumptions" or re-baselining	

2. Has the potential to deliver net benefits to existing and/or future customers

Summary:
We note that the net benefits are modest, partially due to pessimistic assumptions on benefit accrual (not reaching 100% of potential benefits until 2030), as well as the assumption that the LV Templates are only applicable to 50% of GB networks.

2.1. The calculations for net benefits are robust	The calculation of net benefits appears to be robust.
2.2. The benefits claimed are credible	Benefits claimed appear to be credible. We note that the benefits are modest, partially due to pessimistic assumptions on benefit accrual (not reaching 100% of potential benefits until 2030), as well as the assumption that Templates are only applicable to 50% of GB networks.
2.3. The costs are credible	The costs appear to be credible. They are based on one Full Time Equivalent for a year in each Licence Area, as well as upfront cost for monitoring equipment and ongoing rollout of metering equipment for PV installations. No inflation has been applied to costs or benefits.
Re-estimation of net benefits on the basis of "correcting for erroneous assumptions" or re-baselining	

3. Has a Direct Impact on the operation of the distribution system

Summary:
The project focus is on improved understanding of the network via monitoring programs to inform future operational and planning decisions

Monitoring programme will be used to improve understanding of existing network and the pressures of low carbon technology. This improved understanding will develop further the LV template approach and be used for future network planning and investment.

The benefits envisaged relate to network operation, loss reduction and improved network investment.

3.1. Directly contributes to the planning, development and operation of an efficient distribution system.	LV template usefulness will be dependent on how the other DNOs view the selected WPD networks and customer types as representative of GB as a whole. *(DNO comment: WPD use the same Customer Profile Class categorisations as other DNOs, and the same ENA network equipment specifications and network design requirements and principles. The concept of the creation of "templates" for widespread national use has been put forward in the referenced paper from ENA as described in optional Appendix 8)*
3.2. The size of benefits that can be attributed to the Distribution System, taking into account the level of funding requested.	The objective of the project is to obtain an improved understanding of the network via the monitoring and analysis programmes. As such, there is no firm view on what the most appropriate operation of the future will be or where the benefits will be derived. *(DNO clarification: the CBA has identified routes to benefits through network reinforcement deferral, loss reduction, voltage optimisation and spinning reserve)*

4. Generates new knowledge that can be shared amongst all DNOs

Summary:
The project results are predominantly only the measurements from the network itself. This will all be captured and stored by the ENMAC system. Learning from the project will be managed by the Bath University contribution. The LV templates will be based on measurements from the approximately 10% of the South Wales network incorporating areas with both high and low levels of low carbon technologies.

The knowledge generated will be based around measurements and their analysis with no direct intervention or behaviour changes. There is the potential for reasonable levels of data although this is predominantly voltage only with some substation power metering. Therefore, there will be a reasonable volume of data and information.

Dissemination activities involve academic analysis followed by information into the "official channels" as well as academic - and where appropriate - public and industry. It is not clear on exactly what will be provided as outputs or whether raw data will be available - particularly given the NDA signed for the Arbed sites *(DNO clarification: customer privacy and NDA can be maintained by anonymising specific addresses)*

Programme shows half-yearly updates to Ofgem and suppliers, annual ENA conference; external dissemination is shown as only a 2-3 month window at end of project– this is based on a pragmatic requirement of at least one full year cycle of data for credible data analysis.

Learning Chain Summary:
There will be a reasonable level of data being converted into information with some limited knowledge generation. The learning will be predominantly desk-top based as the developed knowledge is not being directly applied to network operation, or influencing behaviour changes.

4.1. Robust methodology to capture the results from the Project	Effectiveness of learning will be dependent on Bath University being able to adequately capture all learning and knowledge development without significant involvement from "coal-face" distribution system planners and operators. *(DNO clarification: the project includes for a network planner to capture, learn and test the DNO use of the data, and to provide the network planning interface with Bath University and other DNO planning interests)* See Box 6 and Appendix D for further details.
4.2. Applicability of the new learning to the other DNOs.	Risk is that the test networks are not adequately representative of other GB DNOs and as such, additional measurement campaigns will be required to revalidate the LV templates for their network characteristics. *(DNO comment: WPD use the same Customer Profile Class categorisations as other DNOs, and the same ENA network equipment specifications and network design requirements and principles. The concept of the creation of "templates" for widespread national use has been put forward in the referenced paper from ENA as described in optional Appendix 8)*

4.3. Effective plans to disseminate learning from the Project	The dissemination plans appear to have a strong academic focus which is a risk given the learning needs to be strongly focused in on the distribution industry itself. Volume and frequency appear quite limited
4.4. Knowledge generated is novel including innovative plans, tools and techniques which will be shared openly and easily with DNOs.	Knowledge will be based around measurements and their analysis with no direct intervention or behaviour changes. Note, the project will test what behaviour changes arise from the 3,000 low carbon installations in the form of their impacts on the network.
4.5. Effective treatment of IPR. (Where a DNO wishes to deviate from the default requirement for IPR)	Default conditions with minor issue on wording from Bath University

5. Involvement of other partners and external funding

Summary:
Key parties involved in the project are summarised below. Organisations with an asterisk represent organisations which could have been categorised as collaborators

	Equipment providers	***Comms. providers***	***Energy retailers***	***Academic organis-ations***	***Project managers/ consultants/advisors***	***Public sector players***
Collaborators			RWE npower	University of Bath		
Partners				Bristol University		Welsh Assembly Government (and Arbed Scheme)
Others mentioned						

Collaborators
Collaborators are all under different ownership and there are varying degrees of commercial dependence/exposure on the success of the project. The benefits to RWE npower depend on extent to which they are looking to develop low-carbon products and services

The project consists of a small team (two collaborators and two additional partners) with previous experience of similar projects.

The track records of the academic partners are established; the details of other technical providers are not provided (especially the suppliers of IT solutions, software, communications) though GE and PowerPlus Communications are mentioned in Box 26 and cost spreadsheets respectively. Given the nature of the project, this is not considered a significant risk.

Following specific questions on progress in identifying suppliers, a response from WPD:
"The final commercial agreements for [substation monitoring equipment] will be put in place once these changes have been agreed and WPD has been successful in securing funding for the project.

WPD has also held a series of meetings and workshops with representatives of QNE who are able to supply Smart Grid Sensors that can be used to monitor voltage etc. on remote premises.

QNE has successfully demonstrated their device to WPD in an office environment and are about to deploy the device in Germany. QNE has provided indicative prices and delivery time scales to WPD for devices required for the project. "

The Track record of RWE npower mentions involvement in programmes and relationships in Wales. The details on their low-carbon products/services are not provided.

There is a memorandum of understanding in place with RWE npower. Details of the agreements with other partners (Bristol and WAG) are not provided .

Partners
The Welsh Assembly Government (Arbed Scheme) are providing critical elements to the project but are not providing funding. Bristol University are hoping to utilize the data, and are therefore not a critical element in the project.

There is no specific partner listed to ensure security/privacy of customer data

External Funding
RWE npower is only providing benefit in kind; including efforts to leverage CERT/ CESP customers and supply partners

No other external funding is being provided

6. Relevance and timing

Summary:
The project will provide useful information on HV/LV transformer and LV network loading together with LV voltage profiles relatively quickly. There are parallel activities occurring within the measurement areas which should provide access to networks with deployed low carbon technologies.

The project outputs, providing correlated against demand and DG connections on the same feeders, will be able to provide information and knowledge that can be fed into DPCR6 plans. The initial focus is on increasing knowledge around the specific characteristics of the network both with and without low carbon technologies.

The first set of information is received back from the meters by 06/2011 so early analysis can begin. First dissemination will be at the ENA conference in 2011.

6.1. The timing of the project is appropriate	Project will provide useful information on HV/LV transformer and LV network loading together with LV voltage profiles relatively quickly.
6.2. Use of solution as part of their future business planning and how it would impact on its business plan submissions in future price control reviews, including DPCR6.	Project outputs, providing correlated against demand and DG connections on the same feeders, will be able to provide information and knowledge that can be fed into DPCR6 plans
6.3. Focus on developments associated with a move to a low carbon economy that are more likely to happen.	The project is not explicitly deriving solutions for increased connection of low carbon technology onto networks, but it will help to inform the connection process through the identification of network types with a greater capacity to absorb low carbon technologies.
6.4. Time to tangible results	Some concern on the fact that the external dissemination is not until 06/2013 which is quite late in the project, particularly given the early availability of measurement information – although it is appreciated that a full year of data is required for credible data analysis.

7. Demonstration of a robust methodology and that the Project is ready to implement

Summary:
A high level plan has been provided with a reasonable level of detail. Key interdependencies are listed in the Gantt chart. Specific individuals are listed on the organogram but details of equipment providers not detailed. The Organisation chart clearly articulates the close link between the project and top WPD management

The project requires tenders to be issued by Jan 2010 with procurement of software providers by 05/11. All internal teams are said to be ready by 04/2011 and when sending customer letters will commence.

Costs have been estimated from number of sources and sources of cost increase considered. Key risks associated with the costs and benefits of the project are identified but not assessed. Risk procedures and processes in place, risk register in place and mitigation and contingency applied.

Domestic customers have no direct involvement but monitoring equipment will be required to be installed on their premises.

The success criteria link across most project areas.

7.1. Detailed Project plan, with responsibilities clearly established and inter-dependencies identified.	Project plan is realistic and appears credible and an attempt has been made to provide links
7.2. Resources to deliver the Project are of a sufficient size and quality to be reasonably expected to ensure its delivery.	Equipment manufacturers have not been identified, but given the nature of the project, it is likely established companies will respond. Organogram identifies individuals for the project increasing confidence in delivery of the project.
7.3. Demonstration that the Project can be started in a timely manner.	Activities required for start-up are clearly described in Gantt chart and the project appears to have gone as far as can be expected until funding is approved. ITTs are ready to be issued for key components; there is a risk that procurement takes longer than planned. This risk raised in questions to WPD is considered low given progress made in discussions with supplier (see topic #5) *(DNO clarification: although not mentioned in the submission, WPD have been in discussion with GE and PowerPlus for over a year)*
7.4. Risks to costs and benefits of the Project have been reasonably estimated.	Selected customers are already covered under existing schemes (Arbed, CEST/CESP programmes), reducing the dependency on related projects not delivering key inputs on time. Risks to timing have been identified- notably availability of meter operators, cooperation at micro-generation sites, customer engagement,) etc; however detailed assessment of impact/probability are not included. These risks could affect deliverability of the project

	There is no explicit discussion of uncertainties related to cost increases but are included within contingency. Details of circumstances for applying for additional funding are not discussed
7.5. Assessment of proposed cost overrun percentage (if non-default?)	Default accepted
7.6. Assessment of Direct Benefit protection (if non-default?)	No direct benefits identified.
7.7. Identification of appropriate risk mitigation processes	Risk procedures and processes in place, risk register in place and mitigation and contingency applied.
7.8. Direct Impact on Distribution Networks on roll-out has been correctly identified	The roll-out of the templates will in theory enable all DNO to better plan, design and manage their networks without the need to undertake the same studies or to fit extensive monitoring equipment on their system. This however would assume that the templates are accepted as valid for all networks.
7.9. Immediate Project impacts on the proposer's network have been correctly identified	Network outages are required during the installation period
7.10. Customer Impact and change required have been correctly identified	Domestic customers have no direct involvement but monitoring equipment will be required to be installed on their premises. The DNO have identified that the smart meters currently available do not have the correct functionality and have proposed alternative equipment for the trial
7.11. Technology Viability	Low risk The proposal is for data collection only requiring the fitting monitoring equipment in both consumer premises and substations with the aim of producing 'network templates'. The need for communications equipment for data transmission is the highest risk but this remains low as the project uses proven technology demonstrated elsewhere. The technology will demonstrate the ability to capture real time data but there is no proposal to use it during the trial The monitoring is in general limited to voltage only (other than substations) and thus may unnecessarily limit any results from the trial.

7.12.Successful Delivery Criteria	Revised successful delivery criteria align with project milestones and timescales provided.
7.13. Contractual proposals	The project does not involve new contractual arrangements
7.14 Derogations and exemptions	