WESTERN POWER DISTRIBUTION

INNOVATION

NETWORK INNOVATION ALLOWANCE (NIA)

SUMMARY REPORT 2015/16

Foreword

Welcome to Western Power Distribution's Network Innovation Allowance Report for 2015/16.

Improving the services we deliver to customers and driving the network to be more efficient through better ways of working has always been at the core of Western Power Distribution's business strategy. The integration of Low Carbon Technologies and Distributed Generation across all voltage levels has significantly altered the way our networks operate and has demonstrated our ability to deliver a robust, sustainable network that can flex to the needs of our customers.

The transition to this new de-centralised energy system requires a flexible approach to accommodate the increased intermittency, variability and volatility of the energy flowing around our assets. We have responded by adopting new technology to make our networks more sophisticated and responsive, forging new relationships with customers and developing our operational practices.

This is the first year that Electricity Distribution Network Operators have had access to funding through the Network Innovation Allowance, however other innovation incentives and mechanisms have steadily ensured that innovation has been embedded into our core business, providing direct customer benefits such as increased network performance and reduced connection times. It is vital that innovation remains a fundamental foundation as the challenges of the future will only be met in an efficient and economic manner by being more innovative with our assets, people and processes.

By carrying out a wide portfolio of innovative projects which build upon what we have already learnt and incorporating successful developments from other DNOs, we can ensure the network will meet all future needs and we will maintain our position as the leading performer in network availability and customer service.

We continue to work together with a wide range of partners across the industry, ranging from small and medium enterprises, universities through to large multi-national companies to develop our knowledge and drive innovation forwards. By sharing research and transferring technology from adjacent industry sectors, we can reduce costs for all our customers whilst delivering an improved network for the future.

Robert Symons
C.E.O. Western Power Distribution

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1. Executive Summary

The Network Innovation Allowance (NIA) was introduced by Ofgem for the RIIO-ED1 Distribution Price Control Review period which took effect on 1st April 2015 and will continue until 31st March 2023. The following on from the successes of the IFI and LCNF mechanisms, Ofgem's continued commitment to innovation is welcomed by Western Power Distribution, as it facilitates the continued application of research and development projects on the network, which should bring significant benefits to our customers in the future.

Innovation is core to our business strategy. We always seek to find better ways of working. We have adopted many innovative ideas into day to day operations that improve the efficiency and effectiveness of the way we deliver our services to customers. Our track record of innovation and change spans from the implementation of good innovative ad-hoc ideas from staff all the way through to formal innovation projects.

This report contains a summary of all NIA activity within the period from 1st April 2015 to 31st March 2016 for the four licensed areas of Western Power Distribution: South West, South Wales, East Midlands and West Midlands. This report has been produced in accordance with the Regulatory Instructions and Guidance (RIGs) issued by Ofgem.

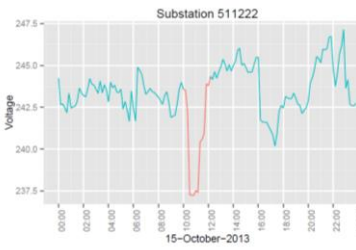
2. Project Highlights

Project Name	Electric Boulevards
Description	This project aimed to facilitate the connection of high power wireless inductive charging for electric buses onto the distribution network.
Lessons Learned	The 120kVA chargers can be accommodated on the existing LV network if the impedance is sufficiently low. Padmount substations and conventional HV substations provide other options for multiple installations or where the LV network is constrained.
Customer Benefits	Through the research completed during the project, it has been proven that the 120kVA inductive chargers can be connected onto the existing LV distribution network, providing the impedance is sufficiently low. By allowing connection of the chargers onto the existing LV network, additional HV reinforcement or augmentation is not required and charges and timescales for connection are subsequently reduced. The cost of full roll-out across the UK could be reduced by over £43.9m.
Planned Implementation	WPD has developed a number of standard connection arrangements for the connection of these inductively powered electric bus chargers. Any future connections requested for using similar equipment will be offered connections based on the template approaches developed within this project. This will reduce the time taken by our planners to analyse the connection of equipment and ensure that the minimum scheme is offered.

Project Name	ECHO
Description	The project aimed to recruit 200 domestic premises to trial a number of DDSR scenarios. The outputs included a report updating the assumptions in the WS3 Transform Model associated with domestic demand response.
Lessons Learned	Whilst the project concluded that domestic DSR instructed directly by the DNO could release a potential thermal transformer & thermal cable headroom of 7.5%, the required level of customer uptake, along with the high cost of implementation and low resilience afforded by the trialled technology, means the solution is not likely to be deployed in its current form.
Customer Benefits	The project has proven that there is a small benefit to implementing domestic DSR, but it requires a low cost solution that has high customer uptake. It may be beneficial to include the functionality within customer-owned white goods, e.g. WIFI enabled white goods where the manufacturer initiates control and collects any demand response payments, in return, the consumer will receive discounted products.

Planned Implementation	It is not planned to replicate the method of demand side management as trialled in the ECHO project. It is clear from the overall cost, participant behaviour and final feedback that the methodology would not be suitable for wider rollout. Based on the feedback received, suggested further work would centre around WIFI enabled 'smart white goods' which require no customer interventions in order manage their own schedules around network demand. Removing the customer from the process would ultimately allow for greater levels of flexibility as devices could be controlled at shorter notice.

Project Name	**Voltage Reduction Analysis**
Description	The objective of this project is to refine our estimates on the effects of voltage reduction on consumption, demand and voltage profiles. By understanding the effects of key parameters current predictions can be improved and the benefits better understood. The assessment of existing profiles should also indicate the available scope for further reduction.
Lessons Learned	Through the use of extensive statistical testing, the VRA project has helped quantify the effect of long term voltage reduction on LV networks. The effects on consumption, maximum demand, reactive power demand and voltage profiles have been identified. Recommendations on voltage control design have also been made as part of the analysis. The 0.88% reduction in voltage settings caused a 1.16% reduction in average demand (equivalent to consumption) over the year.
Customer Benefits	By changing the way the distribution network in South Wales is operated, to reflect the changing requirements of its users, the voltage profile can be altered without any impact on network security or quality of supply. If scaled to the whole of South Wales the reduction in consumption would equate to a yearly decrease of 131.9 GWh, based on the total consumption of 11374.2 GWh. This equates to a saving of £14.9m of customer bills over a year and a reduction in CO2 of ca. 70,000 tonnes.
Planned Implementation	The Research delivered clear and robust answers to the problem being investigated and will enable WPD to change the way it operates its network, specifically in South Wales, but also has applications for the whole UK distribution network. This project has informed a new 11kV AVC setting policy across WPD which will reduce LV voltages. This will also inform any future changes to voltage control design.



3. Our Innovation Strategy

Our innovation projects shape how we are thinking about the future. We will continue to innovate and undertake new projects that will build upon what we have already learnt from the projects we and other DNOs have carried out.

Smart grid innovation projects are grouped into three main categories. These are:

Assets

Projects in this category collect data from the network to enhance modelling. They also test alternative investment strategies that can postpone expensive investments.

Customers

These projects develop new solutions to enable customers to connect low carbon technologies. They may also involve testing of new customer tariffs or working with communities to provide local energy solutions.

Operations

This category of projects demonstrate direct benefits to active network operations from the application of technology.

The projects within the innovation programme are constantly changing as new ones are initiated and existing ones completed. A snapshot of the programme is shown in the diagram below:

Our plans for smaller scale innovation will encompass all of the areas that we have developed in the past, whilst paying particular attention to the establishment of DSO capabilities. We will continue to refine existing innovative solutions across the whole range of business areas and add new innovations as they arise.

We will continue to develop new ideas from a range of sources, including our own teams, our stakeholders, our customer panel, manufacturers, academia, other DNOs, other industries and international developments. As new ideas are developed, we will review and update our project plans.

The latest progress on all of the projects detailed above can be found on both the WPD Innovation Website and the ENA Smarter Networks Portal.

www.westernpowerinnovation.co.uk www.smarternetworks.org

4. Significant Learning

£14.9m

of potential savings on customer bills in South Wales.

CO_2 reduction of approx.

70,000 tonnes.

Potentially releases a further 1.14% of network capacity.

More than

679,000

miles of electric bus travel facilitated.

Wireless charging roll-out will save in excess of

£43.9m across the UK due to learning.

Re-engineering Voltage Control Design in South Wales.

The 0.88% reduction in voltage settings caused a 1.16% reduction in average demand (equivalent to consumption) over the year. If scaled to the whole of South Wales the reduction in consumption would equate to a yearly decrease of 131.9 GWh, based on the total consumption of 11374.2 GWh. This equates to a saving of £14.9m of customer bills over a year and a reduction in CO_2 of approx. 70,000 tonnes.

A 1.14% reduction in maximum demand was also found which could release capacity on the network.

Facilitating Connection of High Power Wireless Power Transfer Chargepoints.

As existing diesel fleets are decarbonised and moved to electro-motive powered vehicles, additional high powered connections will be required on the highway if inductive powered charging becomes popular.

Through undertaking the Electric Boulevards NIA project, it has been proven that the inductive charging modules can be accommodated on the existing LV network after careful consideration and analysis of the network. Furthermore, this process can be accelerated and simplified through the use of template connection arrangements, devised on an equipment-by-equipment basis.

As well as reducing the time to assess the connection, this project could reduce the cost of widescale adoption of inductively powered electric buses across the UK by over £43.9 million.

11kV
rural networks saw
no significant differences
as a result of the Static variable compensators (SVC).

Future SVC
implementation should be concentrated on the
33kV, 66kV and 132kV
network.

Instigating a domestic demand side response event equates to approximately
£6660/MWh...
approximately
50 times the market rate of STOR.

Management of reactive power on the 11kV network using LV connected devices.

The D-SVC Phase 2 project aimed to investigate how the three distribution connected static variable compensators along with a centralised controller could be implemented on a rural network with a significant amount of renewable generation. This project was due to control the reactive power on the 11kV circuits and optimise the network in response to the intermittent generation connected adjacently.

As part of the detailed design, it was shown that the LV connected static variable compensators were not capable of making significant differences to the network voltage on typical 11kV rural networks even with specifically designed transformers.

Further analysis carried out shows that there is limited impact in deploying this technology on the 11kV network and it is suggested that future implementation is concentrated on the 33kV, 66kV and 132kV networks, where more benefit can be derived from the technology due to higher X/R ratios.

Domestic Demand Response Trials.

The ECHO project found that it is a significant challenge for DNOs to engage directly with domestic customers to achieve demand side response and that keeping customers fully engaged in an ongoing basis can be particularly costly. It is recommended that future domestic demand side response systems are fit and forget, with little interaction required by the customers. The retrospective application of this technology into customer homes and lifestyles is also very challenging and more traction might be found if the technology is unobtrusively inbuilt into white-good appliances.

Using the data gathered from ECHO, the customer utilisation payments required when instigating a domestic demand side response event equates to approximately £6660/MWh, which is approximately 50 times the market rate of STOR.

5. Implementation

We deliver innovation through an in-sourced model with a small team of specialists using the resources of our operational teams to deliver tools or products onto the network. The Innovation Team works alongside the company's Policy department where they interact with equipment specifiers and technical experts of the wider business. Once trials are successfully completed, the outputs are taken forward and replicated across our network.

As outputs are delivered, they are developed into new learning that can be taken forward and developed as business as usual. Outputs obtained from other DNO projects are fed into this process to ensure that we gain maximum benefit from innovation projects.

All solutions rolled out from innovation follow the same route as our other policies and techniques introduced into the company. Policies are reviewed by the senior network managers before they are introduced. The rollout process includes implementation plans and, where appropriate, training and dissemination sessions. We monitor all the projects as they develop and make use of learning and outcomes as they are reported.

6. Future Intentions

New ideas also come from several other sources. They can come from within WPD and are often based on improvements to existing practice or recent experiences. They can also incorporate learning from other DNO projects. In some cases academia will approach us with a theoretical idea which we can develop into a solution. We also look for ideas in other sectors where there is the potential for technology developed outside of the electricity industry to be brought in, modified and used.

The ideas we take forward are chosen to support and improve our performance in the broad areas shown on the table below. These areas feed into our main business output headings and will be used to improve our performance in these areas.

Future smaller scale innovation	Safety improvement	Cost efficiency improvement	Customer service improvement	Reliability improvement	Environmental improvement
SF6 alternatives	✓				✓
Integrated Network Model		✓	✓	✓	
Time Series Modelling		✓		✓	
LV Connectivity	✓	✓	✓		
Smart meter data for network operations		✓	✓	✓	✓
Reactive power services		✓	✓		✓
Data Analytics	✓	✓	✓	✓	✓
Carbon Tracing			✓		✓
Distribution Operability Framework		✓	✓	✓	✓
DSO/TSO Shared Services		✓	✓		✓
Visibility Plug and Socket		✓	✓		
Telecoms Template	✓	✓		✓	
Network Analogues	✓	✓		✓	✓
High Voltage Power Electronics Test Lab	✓			✓	
Superconducting Cable Study	✓	✓	✓		✓
Primary Network PQ Analysis			✓	✓	✓
Hybrid Heat Pump Demo			✓	✓	
H2 Energy Balance		✓	✓		✓
EV Smart Charging / V2G		✓	✓	✓	
ENTIRE		✓	✓	✓	
Asset R&D Portfolio	✓	✓		✓	✓
Customer R&D Portfolio	✓	✓	✓		✓
Operations R&D Portfolio	✓	✓	✓	✓	✓

7. 2015/16 Activity Summary

NIA Projects with spend in 2015/16	Internal Costs	External Costs	Total Costs	Status
NIA_WPD_006 Sunshine Tariff	£25,095	£109,387	£134,482	Ongoing
NIA_WPD_007 Airborne Investigations	£7,116	£0	£7,116	Ongoing
NIA_WPD_001 Electric Boulevards	£7,262	£62,742	£70,004	Complete
NIA_WPD_003 ECHO	£18,492	£40,576	£59,068	Complete
NIA_ENWL003 Review of Engineering Recommendation P2/6	£0	£62,273	£62,273	Ongoing
NIA_WPD_005 Losses Investigation	£82,708	£198,374	£281,082	Ongoing
NIA_WPD_008 Improved Statistical Ratings for Overhead Lines	£0	£21,164	£21,164	Ongoing
NIA_NGET0100 REACT	£0	£19,846	£9,846	Ongoing
NIA_WPD_004 Solar Storage	£39,397	£273,153	£312,550	Ongoing
NIA_WPD_002 D-SVC Phase 2	£14,818	£206,129	£220,946	Complete
NIA_WPD_009 SYNC	£23,140	£36,131	£59,271	Ongoing
NIA_WPD_011 Time Series Data Quality	£6,671	£25,936	£32,607	Ongoing
NIA_WPD_010 Voltage Reduction Analysis	£12,905	£135,425	£148,330	Ongoing
NIA_NGET0154 Smart Grid Forum WS7 - DS2030	£0	£177,165	£177,165	Ongoing
Totals	15%	85%	£1,605,905	14 Active Projects in 15/16

Find Out More

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