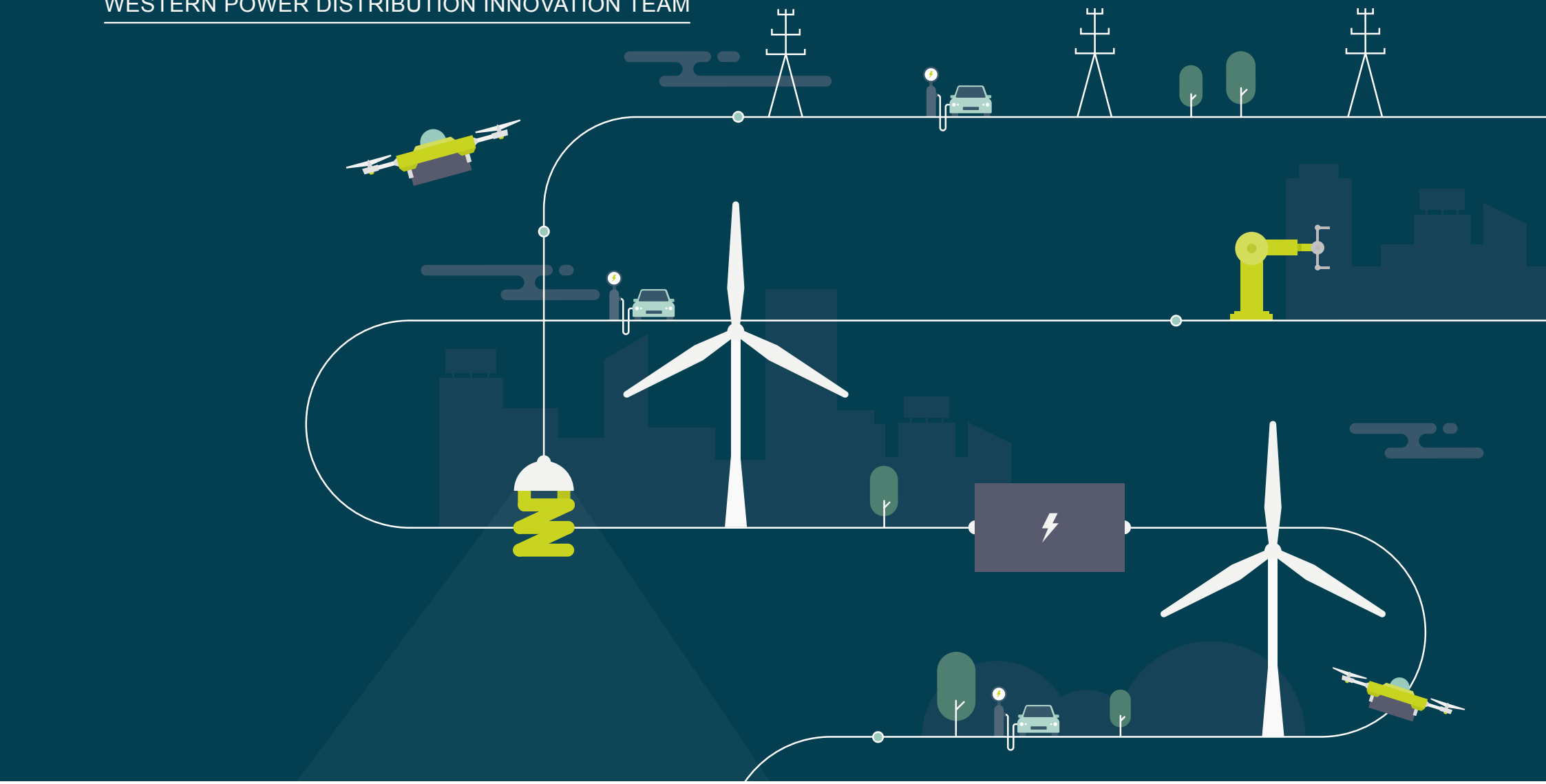
WESTERN POWER DISTRIBUTION INNOVATION TEAM



Network Innovation Allowance

Annual Report 2018/19

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Foreword

Welcome to Western Power Distribution's Network Innovation Allowance Report for 2018/19.

At the core of our business is innovation and we continuously strive to improve the way we deliver our services to customers. Operating a robust, secure and sustainable network whilst adapting it for the changing needs of our customers, looking to benefit from an increasingly efficient and flexible system, calls for us and all Network Operators to continue innovating, both technically and commercially, to ensure an efficient and cost effective electricity system is maintained.

The rapid and continuing uptake of low carbon technologies requires a flexible approach which can accommodate these changes when they arise. We have already taken significant learning from our innovation portfolio and incorporated it in to our business to facilitate this, such as learning from our Entire project enabling our Flexible Power activities.
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.

This report outlines some of the key activities we have undertaken in 2018/19, through the NIA, to deliver against our Innovation Strategy programme of projects. This has seen us generate significant learning in a number of areas such as understanding new technologies connected to our network through the LCT Detection project and the viability of Hydrogen as a source for heat and transport as part of Hydrogen Heat and Fleet.

In order to successfully deliver our innovation programme we continue to work with a wide range of project partners from universities, small and medium enterprises through to large multi-national organisations. We also have a number of NIA projects that are led by third parties, which we have facilitated through our Third Party Call for NIA projects that is now in its second year and has to date enabled 10 projects.

We are committed to using innovation to drive improvements on the network for our customers and to support the Carbon Plan and our Innovation Strategy sets out our plan for this throughout RIIO-ED1.

Phil Swift
C.E.O
Western Power Distribution

Contents

21

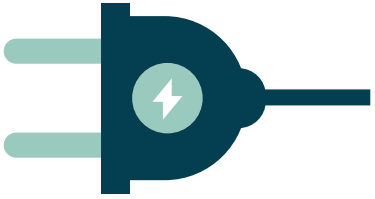
PROJECTS DELIVERED IN 2018/19

NUMBER OF NIA CALL SUBMISSIONS 54

22,000+

HITS ON OUR INNOVATION WEBSITE

LCT DETECTION IDENTIFIED OVER 14,000 TECHNOLOGIES



EVS ON AVERAGE CHARGE EVERY 2 DAYS

47MWh

OF FLEXIBILITY UTILISED AS PART OF ENTIRE

96%

OF NIA SPEND WITH THIRD PARTIES

£18M+

INVESTED IN NIA PROJECTS TO DATE

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. Following on from the successes of the Innovation Funding Incentive (IFI) and Low Carbon Networks Fund (LCNF) mechanisms, Ofgem's continued commitment to innovation is welcomed by Western Power Distribution (WPD), 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 continues to be core to our business strategy and as such we deliver a wide range of NIA projects to trial and demonstrate new and advanced systems, techniques and technologies to support the delivery of a fast changing and dynamic electricity network.

This year has seen us deliver a portfolio of 21 active NIA projects. Two key projects providing significant learning have been LV Connect and Manage, which has demonstrated the effectiveness and customer acceptance of managed electric vehicle (EV) charging and Low Carbon Technology (LCT) Detection that enabled, through advanced data analytics, the detection of otherwise unidentified LCTs connected to the network to enhance network planning and operation.

Following the success of our previous NIA Third Party Call, we ran our second call, where we received over 50 submissions related to four problem statements highlighted in our Innovation Strategy. We have taken two of these projects forwards focussing on increasing transformer capacity for on-street EV charging and advanced fault level monitoring to increased network information to enable increased network optimisation.

We remain committed to continuing and increasing our third party involvement within our innovation programme to deliver innovation outcomes to be taken through to business as usual as quickly and effectively as possible. We also welcome Ofgem's decision to retain innovation funding in the form of the NIA in to RIIO-2, enabling the continued innovative focus on the longer term energy system transition and addressing consumer vulnerability.

This report contains a summary of all our NIA activity within the period from 1st April 2018 to 31st March 2019 for the four licence areas of WPD: South West, South Wales, East and West Midlands. This report has been produced in accordance with the Regulatory Instructions and Guidance (RIGs) issued by Ofgem.

Our Innovation Strategy

6

We rely on innovation to continue to be a frontier performer in network performance and customer service. Innovation is targeted at all the key outputs of safety, cost efficiency, customer service, reliability and environment. In the past innovation has proved beneficial by allowing us to continually improve in these areas. Future innovation will allow us to continue these improvements and will also help us to address the challenges brought about by the Carbon Plan.

Our innovation projects are grouped into three main categories which 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 demonstrates direct benefits to active network operations from the application of technology.

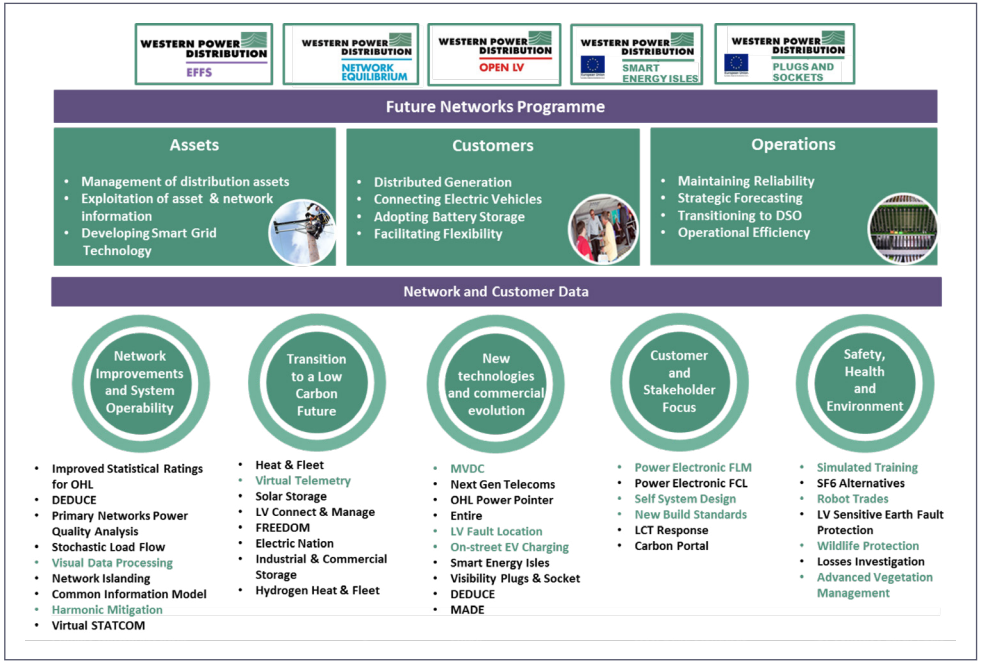
Our Innovation Programme

The projects within our innovation programme are constantly changing as new ones are initiated and existing ones completed. To the right is a snapshot of our current programme.

Our plan for smaller scale innovation encompasses all the areas that we have developed in the past, whilst paying particular attention to the continuing 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 continue to develop new ideas from a range of sources, including our own teams, our stakeholders, our customer panels, manufacturers, academia, other DNOs, other industries and international developments. All our NIA projects involve the interaction with third parties and currently eight projects are led by third parties, which were facilitated through our call for NIA projects.

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.westernpower.co.uk/Innovation

www.smarternetworks.org

Project Highlights Low Carbon Technology Detection

8

For Distribution Network Operators (DNOs), the increasing number of 'invisible' changes (growth of EVs, photovoltaics (PVs) and other LCTs) challenge existing network practices. At present, technology change is outpacing changes in modelling and forecasting of consumer uptake of these beyond the meter technologies; therefore, it is difficult to monitor or understand the change in requirements on the low voltage (LV) network under existing arrangements, without monitoring the technology impacts directly at source, or at least localised substation level. There is therefore a need for a solution that can easily and effectively identify unregistered equipment. The problem this project addressed is how to improve WPD's ability to identify new technologies connected to its network so that future operational and investment decisions can be improved.

Lessons Learned

Significant learning on this project was generated around successfully delivering projects focussing on large data sets. An agile approach, which meant utilising short output focused deliverables, enabled the best outcomes to be quickly identified. This was particularly useful as the specifics of what was to be learnt at the outset was unclear as well as the optimised mechanism and methodology to facilitate it.

Customer Benefits

Two key benefits have been enabled through this project, the first is through the increased knowledge of the LCTs providing and using energy on the network to significantly increase the knowledge of the network enabling further optimisation of the design and reinforcement needs of the system. The second is learning regarding the need for customers to inform the DNO about post meter LCT connections; this project has shown that there could, in the future, be no need for formal notification where an automated detection solution exists. This would further simplify the LCT connection process.

Planned Implementation

This project has shown significant promise in the use of advanced analytics of existing data sets to establish improved knowledge and learning from the network. The recommendation is to carry out further enhancement of the analysis techniques and models used, focussing on the ability to harness unstructured data from Electralink, combine it with advanced analytic systems, and use this to develop a cost-effective virtual monitoring capability, to create a digital twin of the distribution network.

Project Highlights SF6 Alternatives

9

Sulphur Hexafluoride (SF6) gas is used throughout the electrical distribution industry as an insulating medium in switchgear. Whilst it provides many benefits, it is a potent greenhouse gas. Our RIIO-ED1 plan promises to reduce SF6 use on the network while also seeking alternative approaches. Through the this SF6 Alternatives project, we aimed to identify alternative insulating mediums that would be a suitable replacement for SF6 in high voltage (HV) distribution switchgear. The scope of the project included a comprehensive literature review to capture all previous learning from SF6 research and investigation, the identification of key gases to be assessed through initial trials testing of the selected gases.

Lessons Learned

Clear challenges exist in developing alternative products which will be accepted by the market, but also in developing a switchgear product using the proposed mediums. It has been found that compatibility between existing switchgear enclosures is poor and in most cases redesign of equipment was required to accommodate the new medium being used. Therefore, in future projects that would likely involve the replacement of part of a piece or all of existing equipment.

Customer Benefits

The level of learning and body of knowledge has been significantly increased through the development and delivery of this project. There is currently a European wide review of the use of SF6 within the electricity industry, which this project learning has directly fed in to. This project has ensured the latest learning has been developed to drive optimal investment and innovation decisions moving forwards.

Planned Implementation

The learnings of the Literature Review and Test Methodology will be maintained. However, no further implementation is planned at this stage. Until such time that a suitable alternative to SF6 switchgear is available, we will continue to monitor this area with a proposed timescale of 18 months before revisiting this topic.

Project Highlights Hydrogen Heat & Fleet

10

An increase in intermittent renewable generation has pushed some parts of the networks within the WPD licence areas towards capacity making it difficult for further renewable generation to be connected without the need for reinforcement. Consequently solutions that can effectively smooth this generation intermittency and as a result allow further connection of generation are being explored. This project aimed to investigate the feasibility of using excess or otherwise curtailed renewable electricity to generate hydrogen via electrolysis. It has been proposed that the hydrogen generated could be used as a fuel for vehicles and as fuel for combined heat and power plants.

Lessons Learned

The project delivered significant learning, which focussed on the utilisation of the hydrogen having to be significant in order to ensure the investment in an electrolyser is financially viable. The project concluded that the most overall cost effective scenario was to pay for a network upgrade. The most cost effective hydrogen scenario was to use the output to enable a pure hydrogen fuel cell vehicle fleet, due to current fuel costs.

Customer Benefits

Constantly evaluating the most effective and efficient ways to deliver connections to customers is paramount to operating an electricity network. This project has suitably researched alternatives to network reinforcement or generation constraint connections to ensure the current offerings to customers are optimised as far as possible.

Planned Implementation

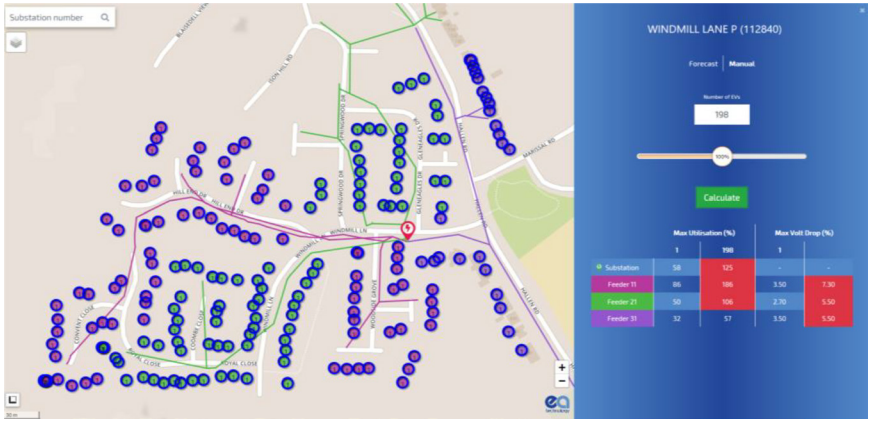
The project has examined the technical and economic feasibility of a concept project such as “Heat and Fleet”, and provided informative commentary on the potential for curtailed electricity production to be channeled towards hydrogen as an energy vector for combined heat and power, and commercial transport. At the present time there is no economic viability in such a scheme, therefore currently there is no further implementation planned. However, we continue to engage with stakeholders, particularly the gas distribution network operators, to review the suitability and applicability of this solution moving forwards.

Significant Learning

11

Electric Nation

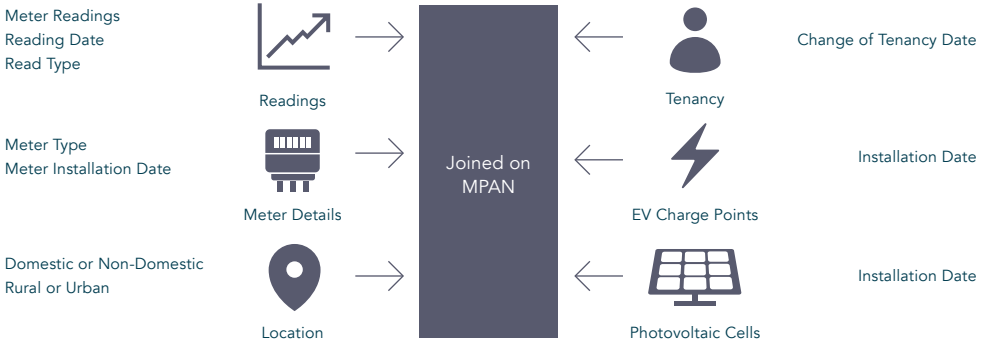
This project involves nearly 700 EVs smart charging, using price and network signals to indicate the optimised time to charge, on the network and enabling us to understand the impact on the network and how constraint issues can be mitigated. It has brought forward the knowledge on the impact of EVs on the distribution network and trialed resolutions, such as the impact of significant clustering of charging and charging time deferment. Participants were surveyed throughout the different stages of the trial, during which they were asked to rate their satisfaction with current charging arrangements. During the initial trial we recorded a 75% satisfaction rate, which increased through the trials to just under 80%. It shows that smart charging did not have a negative impact on the participants.



LCT Detection

This project utilised industry data from the Data Transfer Service (DTS) data set to enable the application of leading-edge analytics to provide improved visibility of EVs and PVs connected to the network. This will also support forecasting of the proliferation of these technologies across networks and other LCT connections to enable enhanced network planning including the options of active/flexible network management. The use of IBM data analysis techniques on both structured and unstructured data enabled the identification of 5,863 EV charge points and 8,104 PV installation predictions, indicating a 13% increase on existing known installations.

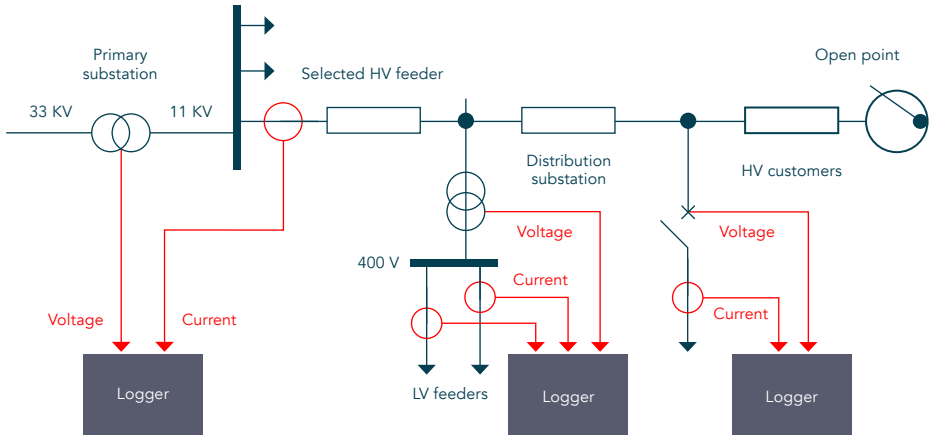
Data



Significant Learning

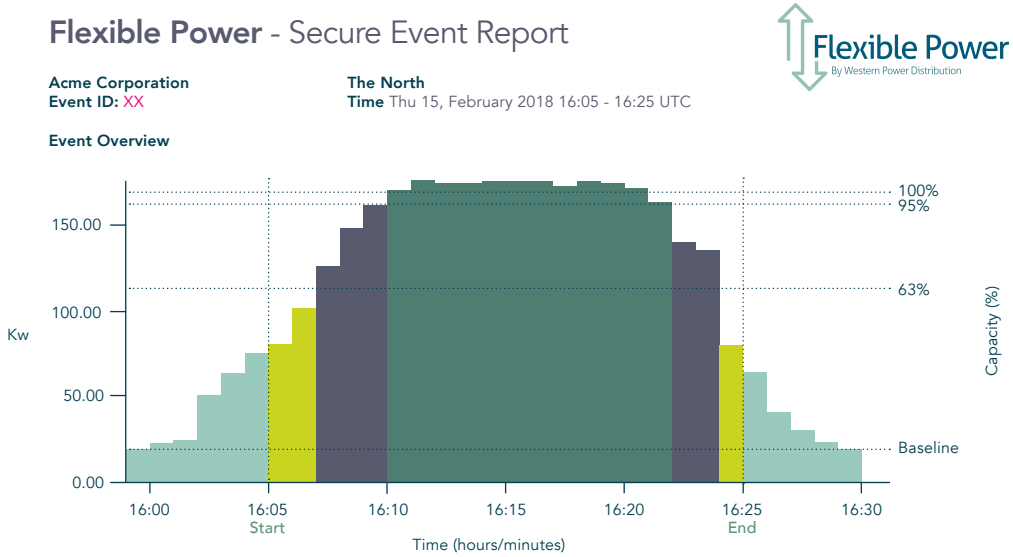
Losses Investigation

This project furthered our understanding of technical losses, which are the losses within a network due to equipment such as cables used to transfer electricity, on the distribution network and helped us target them in a cost effective manner. The project focused on technical losses on the HV and LV networks. Losses were successfully calculated for periods of up to 24 months for 22 HV and LV feeders using monitoring data at all network entry and exit points. Assessment of this data provided insight into key drivers of losses on actual feeders. Utilising a bottom-up assessment of technical losses indicated mean HV feeder losses of 1.47% of delivered power, and LV feeder losses of 1.06% of delivered power.



Entire

Building on previous, limited, Demand Side Response (DSR) trials this project aimed to fully develop and test the skills, relationships and systems necessary for a DNO to provide a comprehensive, commercially effective DSR capability. The project focused on areas within the WPD network that may be due a significant capital upgrade but where the certainty of immediate need is absent. The project developed systems, services and methodologies for participant recruitment, which facilitated over 47MWh of contracted flexibility services. This work has enabled WPD to develop the Flexible Power brand, initiated as part of the project, to offer flexibility as part of our DSO business activities.



Implementation

13

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 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.

Future Intentions

14

We have developed, through customer engagement and stakeholder discussions a wide ranging portfolio of current and future NIA projects. Several of these projects have been formed through our NIA Third Party Calls enabling established and new participants to deliver innovation through the NIA mechanism. Our Innovation Strategy focusses on the needs and inputs to drive innovation and to support this we will be producing an Innovation Forward Plan, which provides an overview of short term priorities to facilitate future NIA Third Party Calls and to clearly identify WPD's innovation needs for future projects.

Projects focus on our three key innovation themes, Assets, Customers and Operations, however, we have made sure that they are also aligned with the five themes from the Electricity Networks Association Innovation Strategy, which is produced by all electricity licenced network operators. A number of these projects also increasingly focus on the delivery of a DSO, enabling DNOs to manage the co-ordination of services at a local level to deliver a more efficient and cost effective whole system.

The ideas we take forward are chosen to support and improve our performance across five broad areas; Network improvements and system operability; Transition to a low-carbon future; New technologies and commercial evolution: Customer and stakeholder focus; and Safety, health and environment.

2018/19 Innovation Project Spend

Project	WPD Spend	External Spend	Total Costs	Status
Statistical Ratings of OHLs	£0.00	£18,434.00	£18,434.00	Closed
Solar Storage*	£8,505.13	-£13,551.18	-£5,046.05	Closed
Common Information Model	£40,408.36	£21,655.00	£62,063.36	Closed
LV Plus	£1,081.89	£8,600.00	£9,681.89	Closed
LCT Detection	£8,670.41	£304,810.00	£313,480.41	Closed
FREEDOM	£28,851.88	£11,976.00	£40,827.88	Closed
SF6 Alternatives	£9,470.28	£17,329.77	£26,800.05	Closed
DEDUCE	£5,934.73	£71,297.00	£77,231.73	Closed
Carbon Portal	£48,529.96	£74,087.00	£122,616.96	Closed
Hydrogen Heat and Fleet	£8,518.19	£35,000.00	£43,518.19	Closed
Assessment & Testing of Alternative Cut-outs	£0.00	£106,337.40	£106,337.40	Closed
Engineered Pole Products	£0.00	£30,533.14	£30,533.14	On-going
CADET	£2,655.78	£77,469.82	£80,125.60	On-going
EDGE FCLi	£19,886.36	£574,620.00	£594,506.36	On-going
Electric Nation (CarConnect)	£14,189.11	£1,549,651.25	£1,563,840.36	On-going
Entire	£74,698.31	£156,396.81	£231,095.12	On-going
Losses	£83,677.68	£189,227.49	£272,905.17	On-going
LV Connect & Manage	£9,502.41	£189,347.38	£198,849.79	On-going
LV SEF Protection	£0.00	£13,195.00	£13,195.00	On-going
Network Islanding Investigation	£2,802.60	£18,610.12	£21,412.72	On-going
Next Generation Wireless	£8,465.69	£67,908.00	£76,373.69	On-going
OHL Power Pointer	£5,024.86	£49,000.00	£54,024.86	On-going
PNPQA	£12,316.68	£187,860.38	£200,177.06	On-going
Smart Energy Isles	£50,169.35	£208,639.36	£258,808.71	On-going
Visibility Plugs and Sockets	£53,244.33	£0.00	£53,244.33	On-going
Virtual STATCOM	£4,513.60	£21,802.50	£26,316.10	On-going
I&C Storage	£33,195.32	£30,378.03	£63,573.35	On-going
Total	£534,312.91	£4,020,614.27	£4,554,927.18	

*Negative spend due to Battery sale, resulting in money returned to customers

WESTERN POWER DISTRIBUTION INNOVATION TEAM

Find out more about all our projects, request access to project data and view upcoming innovation events at:

www.westernpower.co.uk/innovation

Contact us

wpdinnovation@westernpower.co.uk

01332 827 446