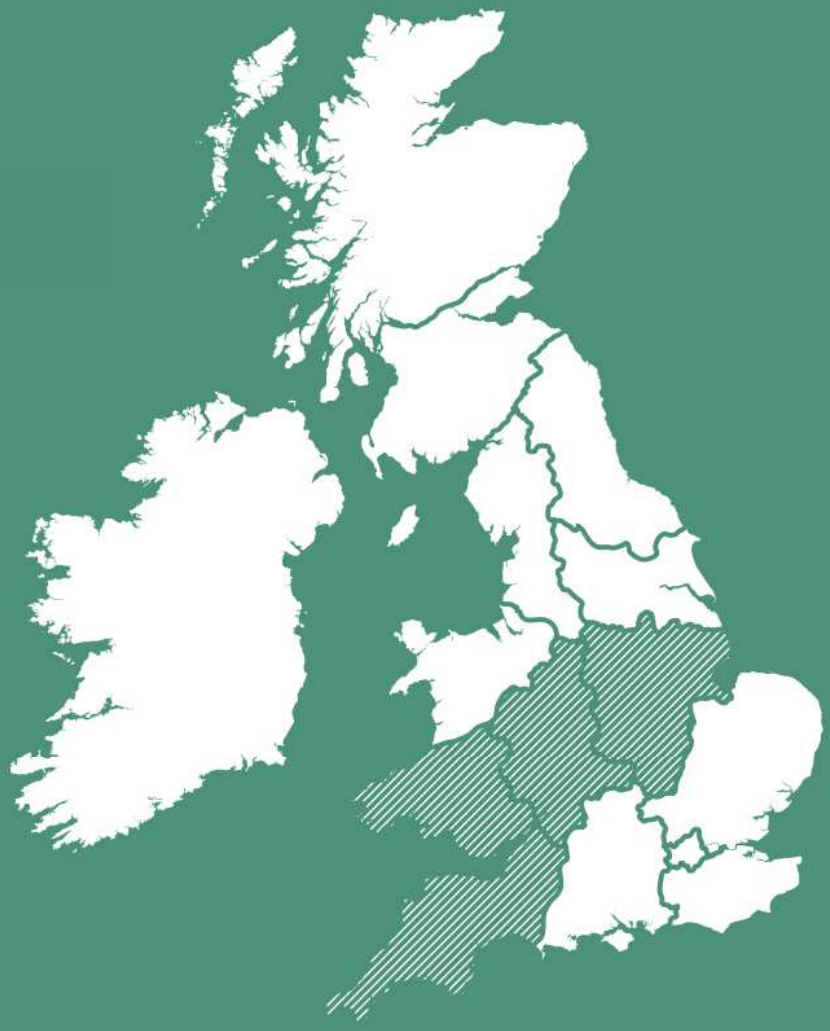
WESTERN POWER DISTRIBUTION

INNOVATION

NETWORK INNOVATION ALLOWANCE (NIA)

SUMMARY REPORT 2017/18



Foreword

Welcome to Western Power Distribution's Network Innovation Allowance Report for 2017/18.

Innovation is at the core of our business 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 vastly changing needs of the network, to incorporate significant levels of new Low Carbon Technologies and offer flexibility services, requires a flexible and dynamic approach to innovation. Through delivering a wide portfolio of innovation projects across our three key themes of Assets, Network Operations and Customers, we have already made significant network developments that have been incorporated in to our business to ensure we can meet the future needs of the system whilst continuing to 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 2017/18, through the NIA, to deliver against our Innovation Strategy programme of projects. This has seen us generate significant learning in many network areas such as Electric Vehicle integration and operation as part of our Electric Nation project and offering flexibility services to customers through Entire.

We continue to work with a wide range of partners from universities, small and medium enterprises through to large multi-national companies. This year also saw our first Third Party Call for involvement in the NIA mechanism. We had over 90 respondents to our call and have taken eight projects forwards, which are captured in our recently updated Innovation Strategy along with our wider programme of projects to support our innovation portfolio for the second half of RIIO ED-1.

Robert Symons
C.E.O. Western Power Distribution

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2017/18 Snapshot

WESTERN POWER DISTRIBUTION INNOVATION

1,399,760 miles driven as part of Electric Nation. Nearly three round trips to the moon!

£11m investment in NIA projects since 2015

75 Hybrid Heat Pumps Installed as part of the FREEDOM project

700+ delegates welcomed to our Balancing Act Conferences

1,610 users of the Carbon Tracing App

21 projects identified for the future

Over **50%** of 2017/18 NIA expenditure with SMEs

21% increase in traffic to the innovation website www.westernpower.co.uk/innovation

91 submissions to our NIA Third Party Call

Over 120km of network assessed for losses optimisation

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. 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 24 active NIA projects. Two key projects providing significant learning have been Entire and FREEDOM. Entire has developed commercially effective Distribution Network Operator (DNO) led Demand Side Response (DSR) through the development of products that allow for participation across a range of market services. FREEDOM, which is a cross vector project in collaboration with Wales and West Utilities (WWU), has installed 75 hybrid heat pumps in domestic properties to understand the benefits of a combined energy source for heating in the home.

Following the success of our previous Network Innovation Competition (NIC) Third Party Calls, we ran our first NIA Third Party Call, where we received over 90 submissions related to challenges identified in our Distribution System Operability Framework (DSOF) document and have selected eight to be taken through as NIA projects in our future portfolio of 21 currently identified new projects within our latest Innovation Strategy.

This report contains a summary of all our NIA activity within the period from 1st April 2017 to 31st March 2018 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.

2. Project Highlights

Airborne Inspections

Currently, WPD's helicopter based overhead electricity line inspections (carried out for WPD and on behalf of two other DNOs) rely on the observer visually (either directly or through cameras) assessing the line and documenting their findings with any significant issues relayed back to the local maintenance team for rectification on return to base. The availability of much improved sensors together with image recognition and wider system integration means that there is now scope for a much more efficient inspection style over a greater length of network resulting in cost savings and improved network reliability. This project aimed to test a range of visual data capture systems, develop some prototype automated assessment algorithms and produce recommendations for a helicopter based system which could provide the data required to be able to perform automatic line condition assessments and defect reporting.

Lessons Learned

One of the main learning points obtained from the project is the fact that, following extensive review of systems used by utilities, search and rescue and military applications around the globe, there are not as many sensors or camera setups available suitable for Overhead Line (OHL) analysis helicopter based arrangements as originally expected. Only two suitable technologies were identified, which meant that it was not appropriate to lease and test multiple units as originally planned. Instead, it was determined that the procurement of a camera, its installation and flight trials to be delivered as part of Business As Usual (BAU) activities. As a result, the project delivered a reduced scope and at a reduced cost.

Customer Benefits

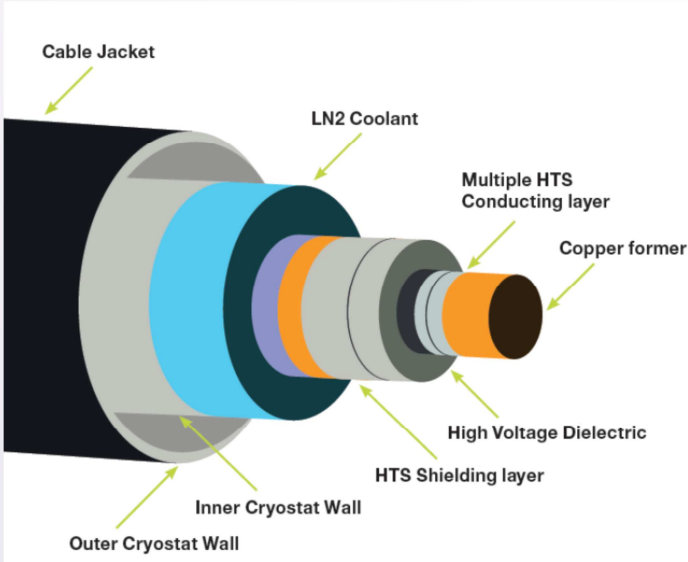
Through the development of advanced inspection techniques, greater lengths of assets to an increased granularity will be able to be assessed. This will deliver both financial efficiencies but also enable network issues to be identified prior to failure and be suitably resolved; meaning a direct benefit to customers through an increase in system security. The project delivered sufficient confidence for WPD to invest in state of the art visual capture systems for its entire aircraft fleet.

Planned Implementation

Our five Airbus EC135 helicopters are now being fitted with updated camera system and a "third seat" mission control desk as a direct result of the project. Based on the positive learning from this project a future project will be undertaken to better understand the analysis of the data obtained from the new systems to assess the performance of the sensor; usage of the data obtained from the flight trials to examine the integration of existing asset information with the data; the development of automatic defect identification using the data collected from the flight trials and; demonstrations to show the integration of existing asset information with camera data and automatic defect identification.

Super Conducting Cables

The increasing number of electricity distribution networks reaching their capacity limits means that the need for network reinforcement will continue to grow. Reinforcing our networks using conventional approaches involves among others, building new electricity substations and installing additional transformers at the sites where capacity needs to be enhanced. This can be incredibly challenging in urban environments due to limited land availability and high costs, creating the need to investigate alternative solutions. The problem can be solved by installing new transformers or substations where it is easy to do so and then transferring their capacity to the networks that need it. Due to their high efficiency, small volume and high capacity, superconducting cables are an attractive solution for connecting new equipment to the physically remote networks that require the additional capacity. In this project, a feasibility study was performed to determine whether such an implementation should be considered.



Source: e.a. A.P. Malozemoff, "High-temperature superconducting (HTS) AC cables for power grid applications", *Superconductors in the Power Grid*, 2015

Lessons Learned

This network feasibility study has offered valuable learning on the superconducting cable technology, its unique benefits, previous implementations and costs compared to conventional solutions. The main learning points have been; costs of superconducting cables vary from manufacturer to manufacturer due to the processes they follow and the materials they use; the relationship between superconducting cable manufacturers and suppliers of superconducting materials is better understood; the comparison of different reinforcement solutions is challenging when performing a Cost Benefit Analysis (CBA) as reinforcement projects usually solve a number of problems including load and asset condition related issues; installation procedures of superconducting cables are similar to those of conventional cables, however, the installation of a superconducting system is still something that is recommended to be done by the manufacturer of the technology as DNOs do not have previous direct experience; and due to the significantly higher costs of the superconducting solution compared to the conventional approaches, a demonstration project is not recommended.

Customer Benefits

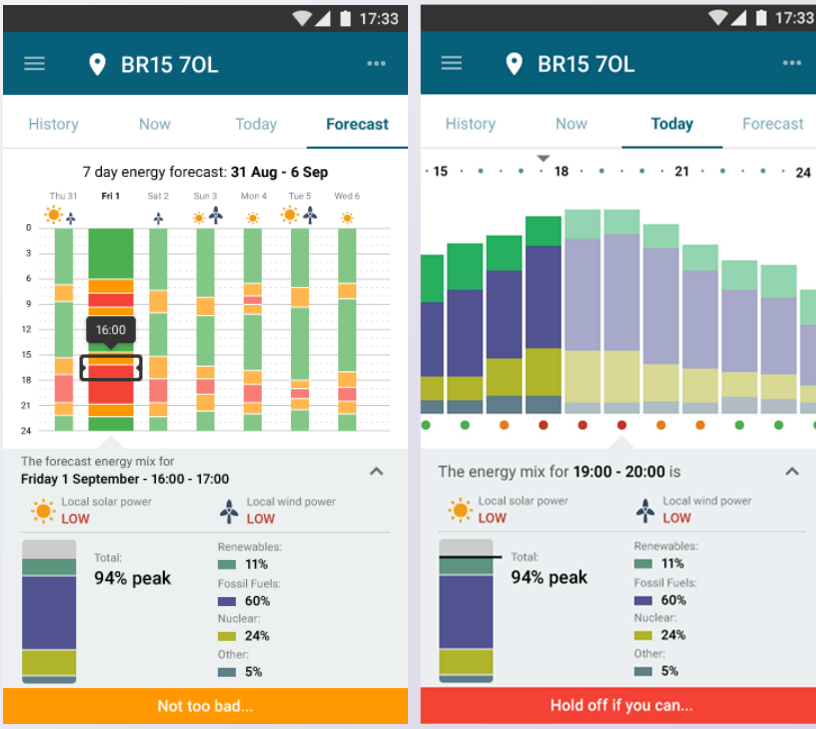
The project has shown that currently the use of superconducting cables on the WPD network is not financially viable; however, the project has taken steps to understanding how they would be successfully modelled and integrated in to the system as and when it is economic to do so.

Planned Implementation

The project has shown that an implementation project is not recommended due to the high initial costs of the technology. However, if the costs of the superconducting technology keep falling by 10 percent every year, it is recommended to re-examine the feasibility of a demonstration project in five years' time.

Carbon Tracing

The project addresses a demand from customers to better understand how their electricity is made up, especially as we continue to see the further adoption of solar and wind generation. This is achieved through the development of state estimation algorithms, analysis of large disparate datasets and the use of a mobile app allowing the bottom line carbon intensity figure to be presented to the users in addition to the split of the overall mix by generation type and with different visualisations such as “Now” (immediate), “Today”, “Forecast” (Next 7 days) and “History” (Last 7 days). The project also found a way to determine whether the information provided could prove useful to users wishing to shape their behaviour according to the carbon intensity of their supply, and whether they would follow through on this potential.



Lessons Learned

The key lessons learnt when delivering the app centred on the availability and utilisation of data. Provision of generation data at particular points on the network is a manual process and would benefit from additional automation functionalities to reduce the time needed to plot and therefore increase the functionality of the system. Another key point was that the areas were created at Bulk Supply Point level, meaning that some urban sites, which covered smaller geographical areas, had less generation attached whilst serving more customers, meaning that these particular areas, due to the app working on the carbon intensity being improved by green generation conditions, were, in some instances, less useful for the user.

Customer Benefits

The app developed as part of the project now enables users to be provided with an indicative overview of the best time to use energy, where usage deferment is possible. It also provides users a useful view of the energy mix in their localised area.

Planned Implementation

The Carbon Tracer app, from the outset of the project, has been intended for direct operation to go live as a “mobile/internet” service to customers as part of the project, and these facilities have now rolled on in to the first year of support to stay live and operational. In addition, we have now initiated a further follow up project to capitalise on the success of Carbon Tracer. The new project is called Carbon Portal and will implement a data access service for external access in addition to a number of Carbon Tracer app enhancements. The Carbon Tracer and Portal data will be used in future behavioural studies to determine the likelihood that customers will flex their consumption dependent on the carbon intensity of the system.

3. Our Innovation Strategy

We rely on innovation to maintain our position as 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.

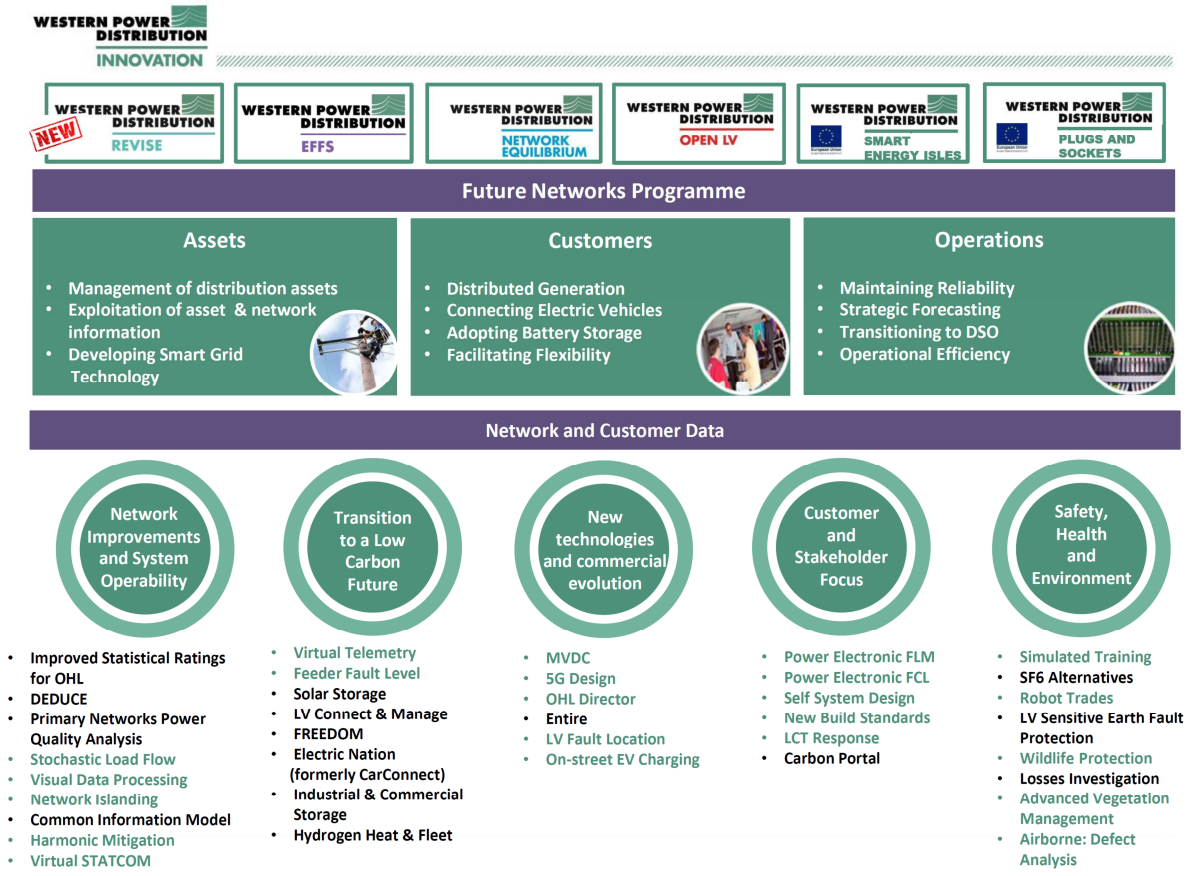
Customers

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.

The projects within our innovation programme are constantly changing as new ones are initiated and existing ones completed. Below is a snapshot of our current programme. For a full overview of our future planned NIA projects see our latest Innovation Strategy.



Our plan for smaller scale innovation encompasses all the areas that we have developed in the past, whilst paying particular attention to the establishment of Distribution System Operator (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. For the first time in 2018 we ran a Third Party Call for projects, which provided eight of the 21 new projects detailed in our revised Innovation Strategy document.

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

4. Significant Learning

OHL Statistical Ratings

Overhead line ratings are built on assumptions from the 1970s. Recent work testing these assumptions has found some of them to be erroneous, with the result that existing distribution line ratings are now considered out of date. In the meantime, changing demands on networks are increasing the pressure to maximise overhead line capacity. This project has, through a demonstration trial, enabled new seasonal boundaries for capacity usage to be identified, which are far more representative of the actual conditions experienced and a revised set of UK standard overhead line ratings are to be produced that will enable increases in ratings to be exploited.

FREEDOM

This project is investigating the suitability and benefits of installing hybrid heat pumps in 75 domestic properties. The project has demonstrated that it is feasible to install these heating systems in a range of different house types (broadly representative of UK housing stock) using wet heating systems and with no in-home disruption from additional insulation measures in 35 private homes and 40 social homes. The energy savings from such a system can be over £700 per year for customers using oil or propane as their primary fuel source.

LV Connect and Manage

LV Connect and Manage aims to demonstrate and prove that LV Active Network Management (ANM) can be used as a short-term measure, whilst network reinforcement takes place, to facilitate the timely connection of customers. The project originally looked to utilise broadband over powerline (BPL) for the communications element of the project, however, it has been determined that the solution is not fit for purpose for this application. This is due to it not being feasible to install repeater equipment in a sufficient number of customers' cut-outs. Furthermore, it was determined that the performance of BPL degrades as the load increases. Since LV Connect and Manage is required to operate to throttle back system use at times of peak, a decision was made that public mobile telecommunications networks were a more suitable solution for this application.

I&C Storage

As connecting new battery systems at larger customer sites often entails costly and time consuming connections this project has demonstrated four alternative configurations for an Energy Storage System (ESS) to determine whether WPD planning assumptions can and need to be adjusted. This project has successfully trialled four battery installations operating in different modes: to manage load and import from the network by peak shaving; generation self-consumption; and demonstrating potential access to wider DSO and National Electricity Transmission System Operator (NETSO) services. When trials are complete it is hoped a set of alternative connection policies can be developed to facilitate simpler, quicker and cheaper connections.

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

We have developed, through customer engagement and stakeholder discussions a wide ranging portfolio of future NIA projects, which are detailed in our revised Innovation Strategy. Several of these projects have been formed through our first NIA Third Party Call enabling established and new participants to deliver innovation through the NIA mechanism.

The projects focus on our three 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 has this year been produced by all electricity licenced network operators. A number of these projects also 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 our five broad areas; Network improvements and system operability; Transition to a low-carbon future. A detailed summary of each of these new projects can be found in our Innovation Strategy in Future Innovations Section 5.3.

7. 2017/18 Activity Summary

	Internal Costs	External Costs	Total Costs	Status March 2018
WPD_NIA_004 Solar Storage	£24,868	£29,616	£54,484	Ongoing
WPD_NIA_005 Losses Investigation	£125,392	£350,801	£476,193	Ongoing
WPD_NIA_007 Airborne Investigations	£1,196	£0	£1,196	Complete
WPD_NIA_008 Improved Statistical Ratings for Overhead Lines	£0	£90,768	£90,768	Ongoing
WPD_NIA_009 SYNC	£6,599	£0	£6,599	Complete
WPD_NIA_013 Electric Nation	£17,905	£2,362,439	£2,380,344	Ongoing
WPD_NIA_014 LV Connect & Manage	£48,632	£616,243	£664,874	Ongoing
WPD_NIA_015 Superconducting Cables - Feasibility Study	£2,537	£16,202	£18,739	Ongoing
WPD_NIA_016 Common Information Model	£66,350	£522,277	£588,627	Ongoing
WPD_NIA_017 Entire	£54,941	£392,541	£447,482	Ongoing
WPD_NIA_018 Electric Vehicle Emissions Testing	£8,119	£80,109	£88,228	Complete
WPD_NIA_019 LV Plus	£0	£11,418	£11,418	Ongoing
WPD_NIA_021 Industrial & Commercial Storage	£32,867	£139,865	£172,731	Ongoing
WPD_NIA_022 Carbon Tracing	£82,195	£251,977	£334,171	Complete
WPD_NIA_023 FREEDOM	£33,689	£820,584	£854,273	Ongoing
WPD_NIA_024 Time Series Data Tool Feasibility	£1,995	£12,984	£14,979	Complete
WPD_NIA_025 SF6 Alternatives	£3,168	£26,460	£29,628	Ongoing
WPD_NIA_026 DEDUCE	£0	£75,214	£75,214	Ongoing
WPD_NIA_027 Smart Energy Isles	£0	£7,015	£7,015	Ongoing
WPD_NIA_028 Primary Networks Power Quality Analysis	£0	£319,675	£319,675	Ongoing
WPD_NIA_029 Visibility Plugs & Socket	£1,975	£0	£1,975	Ongoing
WPD_NIA_030 LV Sensitive Earth Fault Protection	£0	£0	£0	Ongoing
WPD_NIA_031 Carbon Portal	£21,765	£0	£21,765	Ongoing
UKPN_NIA_029 Assessment & Testing of Alternative Cut-outs	£0	£30,022	£30,022	Ongoing
Totals	**£534,191**	**£6,156,209**	**£6,690,400**	**24 Active Projects in 2017/18**
	8%	92%		

8. Find Out More

Website

www.westernpower.co.uk/Innovation

Register for Regular Project Updates

https://www.westernpower.co.uk/Innovation/Contact-us-and-more/Register-for-website-updates.aspx

View Upcoming Dissemination Events

https://www.westernpower.co.uk/Innovation/News-Events/Events.aspx

Request Access to Project Data

https://www.westernpower.co.uk/Innovation/Contact-us-and-more/Project-Data.aspx

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