Electricity network innovation

In 2010 Ofgem announced the creation of a £500m funding mechanism called the Low Carbon Network Fund (LCNF). It allows Distribution Network Operators (DNO) like WPD to test innovative ways of getting the local grid ready for mass adoption of low carbon technologies by customers, such as solar panels, heat pumps and electric vehicles.

The majority of the money is available for projects selected through an annual £64 million competition. In the first two competitions WPD has been highly successful, securing funding for 4 out of the 10 projects the UK. In addition to the competition, each DNO is also allocated a share of £80 million to use on smaller LCNF demonstration projects. This has allowed us to expand our existing research and development programme, and particularly focus on solutions that are at the field trialling stage.

Some of the projects we're currently working on

Lincolnshire Low Carbon Hub
We are adapting a large portion of the 33kV network in Lincolnshire to enable the connection of much more distributed generation (such as biomass fuel power stations, anaerobic digesters and wind turbines) without the need for additional overhead lines, cables and substations. Once the solution is in place the network will be operated dynamically, more like National Grid runs the national transmission system. We will forecast demand and generation in advance, determine the optimum operating method for the network and ensure as much renewable generation as possible is able to supply customers in the area. Any surplus will be fed back into the National Grid.

Low Voltage Network Templates (In South Wales)
The way we design and build the low voltage network has changed very little in recent years. The introduction of low carbon technologies, particularly small scale distributed generation means some of the technical assumptions we make will have to change in the future. Through this project we are monitoring over 1000 substations and fitting 7000 smart meters to get a better understanding of how the local grid is responding to changes in the way customers use electricity. All this will help the development of new network design templates that can be used not just by WPD, but by network companies across the UK.

'FALCON' - Flexible Approaches For Low Carbon Optimised Networks
Our FALCON project is developing a new computer-based modelling tool to help us to identify the best way of delivering investment on the 11kV network, under a set of future energy scenarios. The system will be able to identify the most cost effective "smart" or "conventional" way of delivering additional network capacity to facilitate the UK Low Carbon Transition Plan. The project is based on the network in and around Milton Keynes, and includes a set of "smart" network tests across 200 distribution and primary substations.

'BRISTOL' - Buildings, Renewables, Integated Storage, To Overcome Limitations
This project is breaking new ground by testing a solution that enables customers' equipment to be used to keep the local grid within operating parameters. We are installing storage batteries and new DC wiring in 30 customer homes and 10 local schools, along with solar panels and "smart" domestic appliances. All the equipment will communicate wirelessly with the local substation and through coordinated actions, ensure energy bills are reduced and energy wastage is eliminated.

Western Power Distribution (South West) plc and
Western Power Distribution (South Wales) plc
Registered in England and Wales No. 2366894 & 2366985
Registered Office: Avonbank, Feeder Road, Bristol BS2 0TB

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Using **innovation** to **evolve electricity networks**

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Over 7.6 million customers rely on Western Power Distribution to deliver a safe and reliable electricity supply to their homes and businesses across South West England, South Wales and the Midlands. We keep the lights on by operating the electricity network of wires, cables, poles and substations effectively.

With the emergence of new technologies and innovations, the way we do this has changed through the years. The core network of poles and cables remains, but we have always added new technologies where they provide a benefit. It's our job to keep developing new innovations and make the best use of them in everything we do, to help us rise to the challenges brought about by a low carbon future and the government's Low Carbon Transition Plan.

Our innovation strategy

Innovation must always be compatible with the existing network if we are to provide more efficient networks that are cost effective and reliable for our customers. WPD will therefore focus on four key goals:

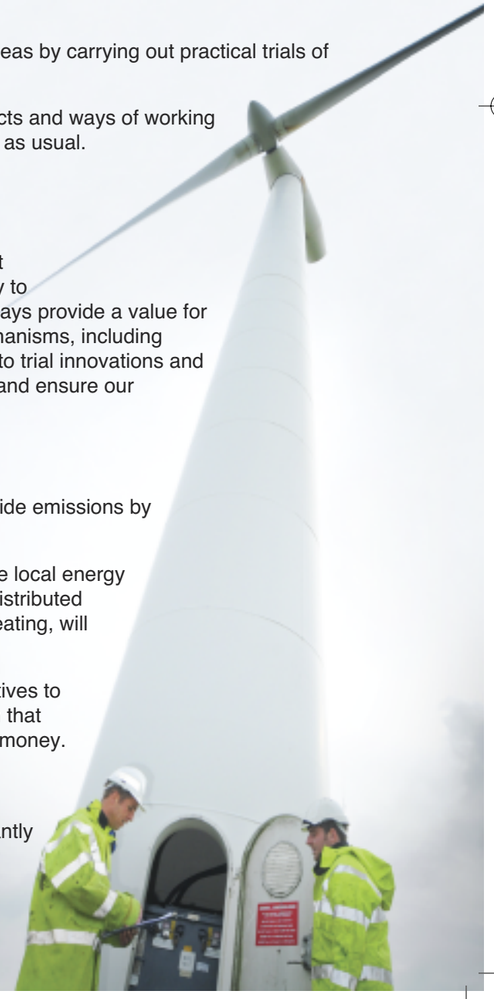
1. **Efficiency and reliability:** We will continue to use innovation to operate the existing electricity network more effectively.
2. **Flexibility:** We will develop technologies to accommodate increases in electricity demand and changes in customer behaviour.
3. **Trial and testing:** We will research and develop innovative ideas by carrying out practical trials of new technologies.
4. **Large scale roll-out:** We will turn successful trials into products and ways of working that can be applied across our network and used as business as usual.

Our values

We will continue to operate a safe, reliable network and deliver excellent customer service. Our staff are encouraged to work in an innovative way to deliver efficiencies to reduce our carbon emissions. Innovation must always provide a value for money solution and we will make maximum use of various funding mechanisms, including Ofgem's Low Carbon Networks Fund and Innovation Funding Incentive to trial innovations and establish the benefits of solutions. We will share our results with others and ensure our solutions are easily transferable to other electricity networks in the UK.

Drivers for change

- **Government targets:** The UK has a bold target to reduce carbon dioxide emissions by 80% by 2050.
- **Increased electricity demand:** Meeting these targets will require more local energy production and the decarbonisation of heating and travel. Increases in distributed generation (DG), electric vehicle (EV) charging and electrically based heating, will all increase demand and put pressure on the current network capacity.
- **Regulatory framework:** Our regulator, Ofgem is offering strong incentives to promote technological, operational, commercial and charging innovation that help network companies deliver improved customer service at value for money.
- **Advances in technology**: A number of low carbon technologies are emerging that place new requirements on our network, such as electric vehicles, solar panels, wind-farms and heat pumps. These may significantly increase the loading of our cables and substations, and change the way power flows around our network.



How we'll use innovation – our strategy in detail

• Efficiency and reliability:

Operating the existing electricity network more effectively.

We currently distribute electricity via 184,000 substations and 216,000km of overhead lines and underground cables – that's enough to go around the world more than five times! Whilst power cuts do occasionally happen, on average the network is available 99.99% of the time and much of our equipment will continue to operate effectively for decades to come. New ideas and technologies that we develop must support the current network, so that we continue to deliver a reliable electricity supply.

• Flexibility:

Developing technologies to accommodate increases in electricity demand and changes in customer behaviour.

The Government's Low Carbon Transition Plan means that customers are more likely to use electricity for heating and transport in the future, which will see an increased demand for electricity. The long established network must be adapted and improved to support this change. For example, new developments will allow us to use the network more flexibly to meet peaks in electricity demand without the need for traditional network reinforcement.

• Trial and testing:

Researching and developing innovative ideas by carrying out practical trials of new technologies.

Using the Innovation Funding Initiative, we will take ideas and fund research to develop products and ways of working that can be used on the network. As part of Ofgem's Low Carbon Network Fund (LCNF) we will submit bids for projects that trial new technologies and approaches to facilitate the networks of the future.

• Large scale roll-out:

Turning successful trials into products and ways of working that can be applied across our network and embedded into the way we do things.

Once trials are successfully completed, ideas will be taken forward as products and strategies that can be replicated across our network, as part of 'business as usual'. When adding new assets and equipment to the network we will be practical and do so with the future in mind. Cable types and designs, and the way we configure sections of the network will all be developed to accommodate the increased electricity demand we anticipate in the future.

How we'll deliver innovation – our future networks programme

We will implement this strategy through our specific future networks programme. We will also work closely with the operational teams who deliver our current levels of service and who best know the requirements of our existing networks as well as any opportunities for improvement.

Early innovative solutions, such as 'switchgear automation', which allows us to reconfigure the network to re-route supplies and restore power quicker when there's a problem, are now seen very much as a business as usual. Future solutions must be able to be easily recreated across WPD's network and also the other electricity networks in the UK.

WPD has a key part to play in helping customers to adapt to a more flexible way of using electricity. We will work with various stakeholders to help engage people in new projects, all of which will help customers, equipment providers, generation providers, suppliers and other DNO's to adapt to a low carbon future.

In line with WPDs innovation strategy our future networks programme focuses on 3 key pillars:

1. Networks: Large scale demonstration projects, covering each network voltage level. These projects give us valuable insight into the effectiveness, costs and benefits of smart grid solutions and help inform our investment assumptions for long term planning.

2. Customers: Delivering a portfolio of projects aimed at helping our customers connect low carbon technologies to the local grid. We aim to develop a "toolkit" of innovative solutions to make it quicker and cheaper for customers to connect to the network.

3. Performance: Exploring ways to improve the service we offer customers and reduce our own operational costs. For example, exploring the benefits of more active management regimes for the grid, including solutions offered by customers and other market participants.

Some of the areas we're focussing on:

Substation monitoring

Key to many of the decisions we make about running our network is first of all understanding the actual performance of the system. At the higher voltages on our system we have wide-scale monitoring and telemetry to help inform our operations. At the lower voltages, system monitoring is less common and networks tend to run passively.

We are now installing detailed substation monitoring at some of our sites, primarily to understand the effects of new technologies, but also to help understand how our assets perform on a day to day basis.

Smart metering

Between 2014 and 2019 every domestic gas and electricity meter in the UK will be exchanged for a smart meter. What makes them smart is the ability to automatically collect meter readings and utilise two way communications to automatically return the readings to the energy suppliers. In addition we will be able to gather remote data on how our network is performing. This may include system voltage information or even allow us to remotely ascertain if you have had a power cut.

Integration of solar panels

The number of installed solar panels (also known as Photo Voltaic Panels) has been steadily increasing throughout the UK. This presents a new challenge to the operation of our networks. When the majority of UK networks were designed, it was anticipated that power would flow from large centralised generators one way through the network before eventually arriving at the plug. With the introduction of PV panels certain conditions can occur, where generation is high and energy usage is low, and we can experience two-way power flows, back through our network. Intermittent weather also means the power output varies.

We are working on a number of projects to assess the effect of dense PV panel installations and how we can facilitate this form of low carbon generation most effectively.

Telecommunications

Underpinning a number of our new innovations, is a high speed dedicated communications network. We already use various communications systems to help monitor and operate our electrical assets. We are continuing to develop this capability to meet the ever-growing requirements for accurate and timely data that helps us to run the network as efficiently as possible.

Dynamic asset rating

All of the pieces of equipment that make up our network are rated as to how much power they can carry. This is primarily due to the assets getting hotter the more electricity passes through them. A simple way of managing this is to prescribe two seasonal capacity ratings, one for summer (when the ambient air temperature is high) and another for winter (when the air is cooler). However this simplification can mean that at times we do not get the most out of our assets. Dynamic asset rating takes into account actual meteorological conditions such as the air temperature and wind speed. This can then be used to calculate a real time rating for the assets, allowing us to run our transformers, lines and cables more efficiently.