June 2019

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

2

Contents

1. Overview

Western Power Distribution (WPD) is the distribution network operator (DNO) for the Midlands, South West and South Wales. We are responsible for delivering electricity to approximately 7.9 million customers in the UK.

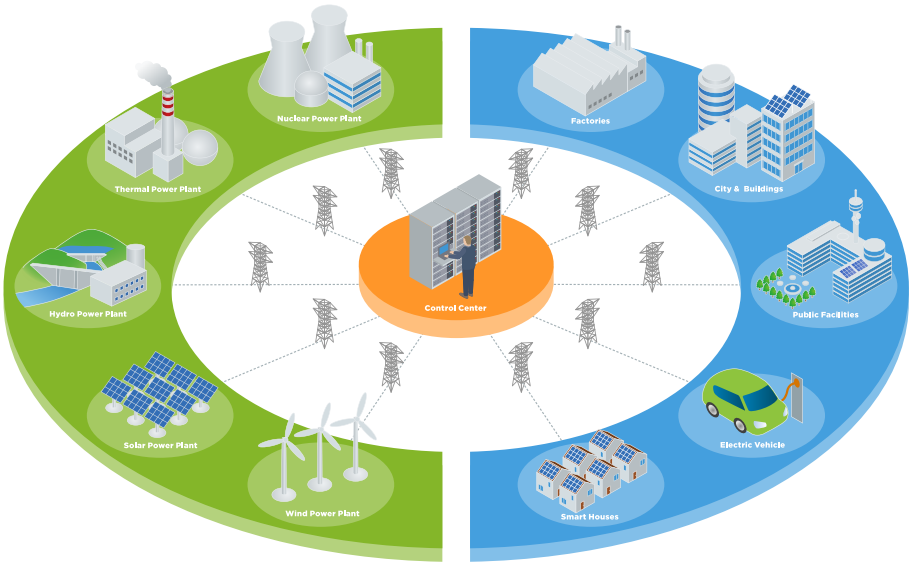
The UK's electricity system is undergoing a rapid period of change as distribution network customers invest in generation and alter their consumption behaviours to influence a lower carbon future. To enable a greater volume of demand, generation and storage to be connected, our networks are becoming smarter and more active. Creating a more efficient and flexible system will benefit all customers and empower them to be at the centre of the energy revolution.

We recognise that the change from a Distribution Network Operator (DNO) to a Distribution System Operator (DSO) is essential to driving performance and efficiency from our network and ensuring it can meet the future energy demands of all our customers. The enhanced capabilities we are developing will also give our customers the freedom to access other opportunities within the developing energy system.

Within a rapidly changing energy landscape, our aim is to keep our business simple, to deliver on our promises and continue to innovate. Customers will receive the highest levels of customer service at an efficient cost and WPD will continue to be the industry leader in electricity distribution.

Our engagement will have to be creative and widespread through multiple channels. This document is part of that process.

All of our stakeholders will benefit as we transition to managing more active networks and informing them of our immediate next steps and guided trajectory will help them to transition with us. Through detailing the expected benefits and timescales, we can help support the delivery of the UK's Industrial Strategy.



9.9GW

Installed distributed energy resources within WPD area

73,074GWH

Energy distributed across WPD networks in 2018/19

2. Role of the Distribution System Operator

> CREATING A MORE EFFICIENT AND FLEXIBLE SYSTEM WILL BENEFIT ALL CUSTOMERS AND EMPOWER THEM TO BE AT THE CENTRE OF THE ENERGY REVOLUTION.

Western Power Distribution has a proven track record on delivering industry leading performance across a number of key distribution network operator activities. Its experience in adapting to change provides a strong platform for coordinating the electrical systems of the future.

1. KEEP THE LIGHTS ON BY OPERATING OUR NETWORK ASSETS EFFECTIVELY
2. MAINTAIN EQUIPMENT SO THAT THE NETWORK IS IN A CONDITION TO REMAIN RELIABLE
3. FIX THE NETWORK IF EQUIPMENT GETS DAMAGED OR IS FAULTY
4. CONNECT CUSTOMERS BY UPGRADING EXISTING NETWORKS OR BUILDING NEW ONES

As we transition to becoming a Distribution System Operator (DSO), and we take on additional roles within the developing energy system these roles will require an increased level of coordination with existing operators and consumers, as well as the creation of new forms of coordination with emerging energy system participants.

1. PROMOTE INNOVATION, FLEXIBILITY AND NON-NETWORK SOLUTIONS
2. FACILITATE NEUTRAL MARKETS FOR MORE EFFICIENT WHOLE SYSTEM OUTCOMES
3. IMPROVE THE RESILIENCE AND SECURITY OF THE ELECTRICITY SYSTEM AT A LOCAL LEVEL
4. DRIVE COMPETITION AND EFFICIENCY ACROSS ALL ASPECTS OF THE SYSTEM

2. Role of the Distribution System Operator

As energy becomes more decentralised and its consumption becomes more varied, the Distribution System Operator will have a significant role in optimising actions at a local level and ensuring regional resources can support delivery of an efficient and resilient system.

WPD's DSO Strategy highlights the four key areas we will focus on to deliver these benefits:

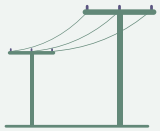
1

OPTIMISE INVESTMENT IN HIGHER VOLTAGE NETWORKS

2

CONTRACT WITH CUSTOMERS FOR NON-NETWORK SOLUTIONS

3



CO-ORDINATE AT TRANSMISSION/ DISTRIBUTION INTERFACE

4

PROTECT THE INTEGRITY & SAFETY OF LOWER VOLTAGE NETWORKS

2. Role of the Distribution System Operator

WPD is actively committed to developing the industry transition towards DSO through the Energy Networks Association's Open Networks Project. This project aims to understand the requirements and effects of moving to a more active distribution system. It also aims to design, test and implement the whole system elements which will bring benefits to all energy system participants.

The objectives of the overall Open Networks Project are to:

- Put ENA members on the front-foot to drive change that aligns with their strategic objectives for DSO, rather than being driven by other initiatives
- Provide a consolidated and agreed position across all ENA members as to what DSO is and how it might operate with TSO
- Inform all ENA members of the potential impact of DSO and to propose potential actions to facilitate and make the most of this transition for ENA members
- Set out a strategy and plan for delivery of DSO and to take action to prepare for delivery
- Share non-sensitive information across ENA members to ensure that they are at the forefront of learning on the DSO transition and understand the key messaging of the project
- Inform the regulatory debate around funding (including ET2 & ED2).

2017: DSO definition and Improvement Principles

- DSO definition and functional capabilities
- Commercial principles and pathways for procuring flexibility
- Detailed modelling of Future Worlds
- Development of whole system processes across T-D
- Implementation of short term T-D improvements
- Information provision for connections

2018: Detailed DSO assessment & Improvement Development

- Detailed modelling of Future Worlds
- Independent impact assessment of Future Worlds
- Development of whole system processes across T & D
- DSO flexibility products and end to end process
- Implementation of short term T-D improvements
- Best practices for connections

2019: Support Policy decisions and Improvement Implementation

- Impact Assessment Consultation
- Output provides evidence to BEIS & Ofgem
- Development and implementation of improvements
- Convergence of flexibility services
- Design flexibility platforms
- Trials to test DSO functionality
- Further detailed modelling of shortlisted Future Worlds
- Scoping whole energy system products

Regulatory Enactment & Implementation

- Regulatory changes to allow implementation of preferred Future World/s
- Ongoing DSO trials
- Implementation of preferred Future World/s
- Ongoing convergence of DSO flexibility services
- Implementation of flexibility platforms
- Continuous Improvement

3. DSO Forward Plan Roadmap

	Looking Backwards			Looking Forwards		
Neutral Supply Market Facilitation	76 primary substations with flexibility in 2018 with 261 MW of interest	Consultation on Signposting of distribution system needs, including visualisation and data provision	Data on Signposting publicly available for download	Commitment to publish more data on system needs	Working with stakeholders to further develop market information	Development of a Flexibility Register for those offering services
Enabling Decarbonisation	Suite of four different Alternative Connection types developed	Alternative Connections rolled out as business as usual	Connection of 9.5GW of distribution connected generation	Strategic Investment Options developed for future generation scenarios	Active Network Management available in all areas by 2021	Roll out of flexibility will enable additional connection options
Flexibility Services	ENTIRE project proving benefits of flexibility	Flexible Power brand procuring flexibility services under business as usual	Over 380MW of flexibility responded to expressions of interest. 28 out of 32 zones taken forward	Seeking further summer and winter flexibility services in 2019	Signposting zones out to 2024	Openly testing the market to compare flexibility against conventional reinforcement
Electric Vehicle Readiness	Over 9,500 EV domestic chargepoints connected without reinforcement	Our innovative EV trial, Electric Nation has shown that EVs do not charge every day	We have issued our first EV Strategy and have also updated guidance to local authorities	Trialling three phase service cables for new domestic connections	Developing a solution for hub charging installations at car parks and public places	Continued selective uprating of assets in LCT hotspots
Enabling Economic Growth	Strategic Investment Options reports published for all four license areas	Stakeholder engagement completed in all regions	Publication of four Distribution Future Energy Scenario reports	Refresh DFES and Strategic Investment Options reports on a two year cycle	Engagement with Government on Local Energy Strategies	Continue to share forecast data with local and regional Government and other stakeholders
Whole System Planning	Installation of FREEDOM test sites	Completion of WPD & NG Regional Development Programme for South West	Development of industry under ENA's Open Networks	Collaborative Strategic Investment Options reports with other DNOs	Joint SO and DSO articles published under WPD DSOF	Development of the Heat and Fleet project
Communities and Localism	Wide range of innovation projects centred around local communities	Community energy events held in major locations within WPD area	DNO to DSO community consultation published	Continued engagement with local communities enabling them to participate in future energy markets	Development of the MADE project	Develop outputs of Open LV project into BAU

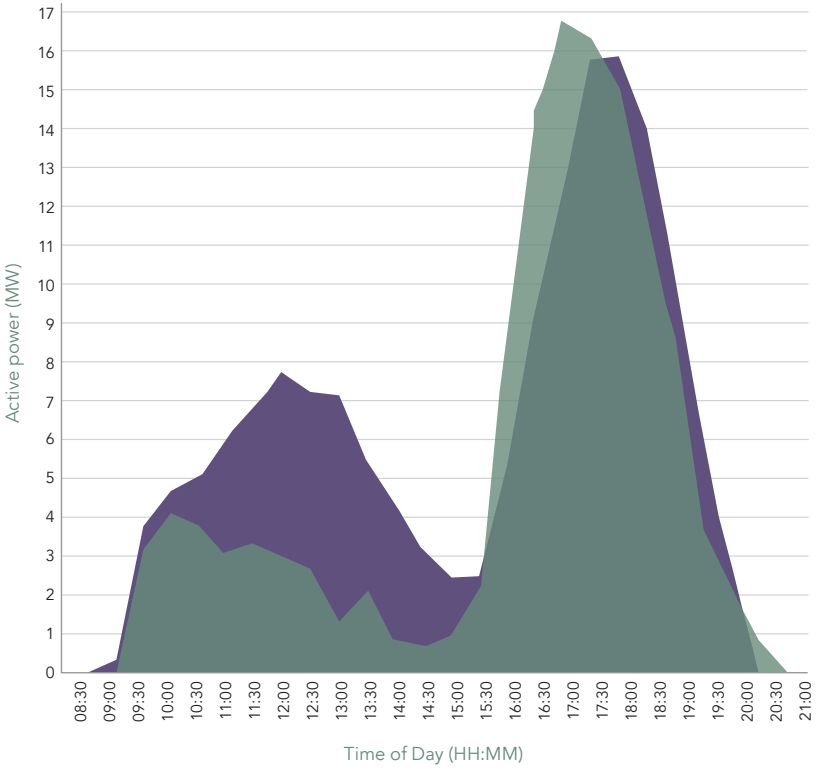
4. Neutral Supply Market Facilitation

Facilitating new neutral markets around flexibility is a key objective in WPD's DSO Strategy. As the energy system becomes more active, an important role for WPD will be to provide the right information to signal the needs of the electricity distribution network to the markets.

This will require us to provide a greater level of information on the performance characteristics of our network than ever before and in a format which is understandable and transparent. The information we present will inform the market ahead of us requesting tenders for flexibility and allow flexibility providers to understand our potential requirements for demand side response.

> BY PROVIDING MORE INFORMATION ON ITS SYSTEM NEEDS, WPD CAN BECOME A FACILITATOR OF NEUTRAL MARKETS.

Adelaide Road – 330014 – MW Service availability windows



Legend/MWh availability

- May 222.61 MWh
- June 139.1 MWh

Areas of our network with flexibility requirements that are currently being procured will be published on our main website and expressions of interest will be handled through our Flexible Power brand.

WPD's network flexibility map shows information on flexibility zones under 'Live Procurement' and 'Signposting'. Zones in 'Live Procurement' detail the actual requirements for the flexibility WPD is seeking expressions of interest for.

'Signposting' provides data on WPD's distribution system needs in areas that we expect to become constrained for demand in the near future, under a number of future energy scenarios. Through this signposting work WPD is aiming to describe what generation turn up/demand turn down behaviour we may need (the months required, the MWs needed and predicted availability windows). It is also trying to quantify a likely market volume of energy (MWhs per month). However, it is not a here and now requirement nor does it indicate that flexibility is the only or best solution.

www.westernpower.co.uk/network-flexibility-map

5. Flexibility Services

Enabling flexibility in the electricity system is core to the UK's Smart Systems and Flexibility Plan and WPD is responding through the wide-scale roll out of demand side response and alternative connections.

The development and wide-scale adoption of these technologies will embed flexibility throughout the whole electricity system.

Demand Side Response

Our NIA project Entire sought to prove the effectiveness of DSR and develop the mechanisms used by network and system operators to realise the benefits provided by flexibility. We have rapidly implemented the successful learnings from this innovation project into Business-as-Usual, with our first flexibility tenders being handled by the main business during Summer 2018.

The need for network and system operators to publish information on system needs will continue to grow in importance. Our Signposting information will begin to provide current and forecast data on what would most benefit our system.

Active participants within flexibility markets will be able to alter their behaviour to minimise conflicts on the network and maximise their potential revenues. As well as requiring information on network congestion and its impact on charging, participants will also want to see what capacity might be available so they can offer services to other energy system operators without the risk of curtailment.

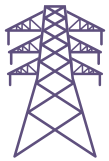
Areas of our network with flexibility requirements that are currently being procured will be published on our main website and expressions of interest will be handled through our Flexible Power brand.

www.flexiblepower.co.uk

Alternative Connections

As network operations move from passive to a more active model, the range of alternative ways of connecting customers to the network will increase. Customers will have more choice in the contractual terms for accessing network capacity and will be able to select which connection options best suit their requirements.

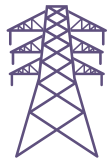
These are particularly useful in areas of constraint, where the connection cannot be accommodated without network reinforcement and where connection of additional flexibility would benefit adjacent network users.



76

Primary substations requiring flexibility in 2018

Flexible Power
By Western Power Distribution



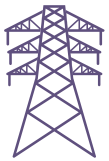
261MW

of interest from market participants during 2018

5. Flexibility Services

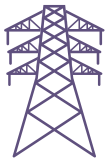
WPD believes that flexibility services will play a key role in delivering an economic and efficient electricity system. As well as ensuring its own network is developed to be as smart and flexible as possible, WPD will be working in partnership with flexibility providers to maximise the benefits they can provide to the whole system.

Demand side response is being rolled out across the business where we anticipate that flexibility can economically provide an alternative to reinforcement. Our business as usual deployment has already sought expressions of interest for flexibility in 18 zones across the WPD region in 2018 and has published requirements for over 110MW of services.



18

New flexibility zones for 2019



22.1GWH

Maximum flexibility availability required in 2019

Timeline for flexibility in 2019

SIGNPOSTING
Early February 2019

DYNAMIC PURCHASING
February 2019

PROCURE
March to May 2019

INTEGRATE/TEST
May 2019

OPERATE
June 2019 to May 2021

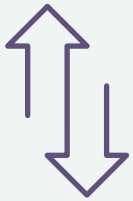
Intentions for 2019

Throughout 2019, flexibility will form an increasingly greater part of our investment strategy for developing our network.

Our signposting work aims to catalyse markets in areas where we are expecting constraints to appear and as we begin to see these manifest, flexibility will be deployed as a primary response to avoid network limits being exceeded. The speed at which flexibility can be mobilised will help us to operate more efficient networks.

WPD has committed to openly test the market to compare relevant reinforcement and market flexibility solutions. We will do this by increasing the transparency and availability of our data and information to the market and by opening up network requirements to market competition on a business-as-usual basis.

Throughout the rest of ED1 we will assess 90% of our load related reinforcement investment for a more economic delivery by flexibility services.



90%

LRR investment assessed against Flexibility

For the remaining 10%, which is predominately at LV, we will continue to develop, test and evaluate other markets.

6. Electric Vehicle Readiness

The use of electric vehicles is on the rise and they are expected to play an important role in achieving the UK's targets for improving air quality and reducing carbon emissions.

There are now over 193,000 electric vehicles in the UK with 60,000 registered in 2018. That number is predicted to rise substantially as we move towards the 2040 deadline for zero emission vehicles.

The demand for domestic and on-street charge points is likely to rise, and WPD is pro-actively making its network electric vehicle ready.

OVER 9,500

EV charge points have been connected to WPD's network without reinforcement.

Forecasting regional EV demands

- Through our Future Energy Scenario work, we are forecasting regional EV projections across a number of political and economic outlooks. We use this information internally to determine Strategic Investment Options. We also share this information externally to help inform local government strategy.

Selective uprating of assets

- Equipment placed on the network today will still be in service in 2050 so we must plan for this future change in demand.
- By refining the regional projections further, we have developed a distribution transformer level forecast, which estimates the likelihood of EV uptake at each one of our 185,000 substations.
- Using this data, are already selectively uprating assets on the HV and LV networks, based on a detailed economic assessment.

Electric Nation

- Electric Nation is the UK's largest EV trial, recruiting 700 drivers to better inform our assumptions about EV charging behaviour.
- The project has shown how users charge, allowing more EVs to be connected to the distribution network without reinforcement.
- By working with EV charging aggregators, we are trialling the commercial mechanisms to demonstrate EV flexibility as paid-for-service.

LV Connect and Manage

- LV Connect and Manage is a NIA project which is developing the technology needed to implement Active Network Management on the LV distribution network
- This technology will allow WPD to react quickly to the issue of local clustering behaviour and reduce the time to connect LCTs.

EV Strategy

- We issued our first EV strategy in 2019
- It shows how we plan to accommodate EV connections on our existing network
- We will use flexibility products where EV clusters exist
- The strategy includes options for connections at car parks and fuel stations

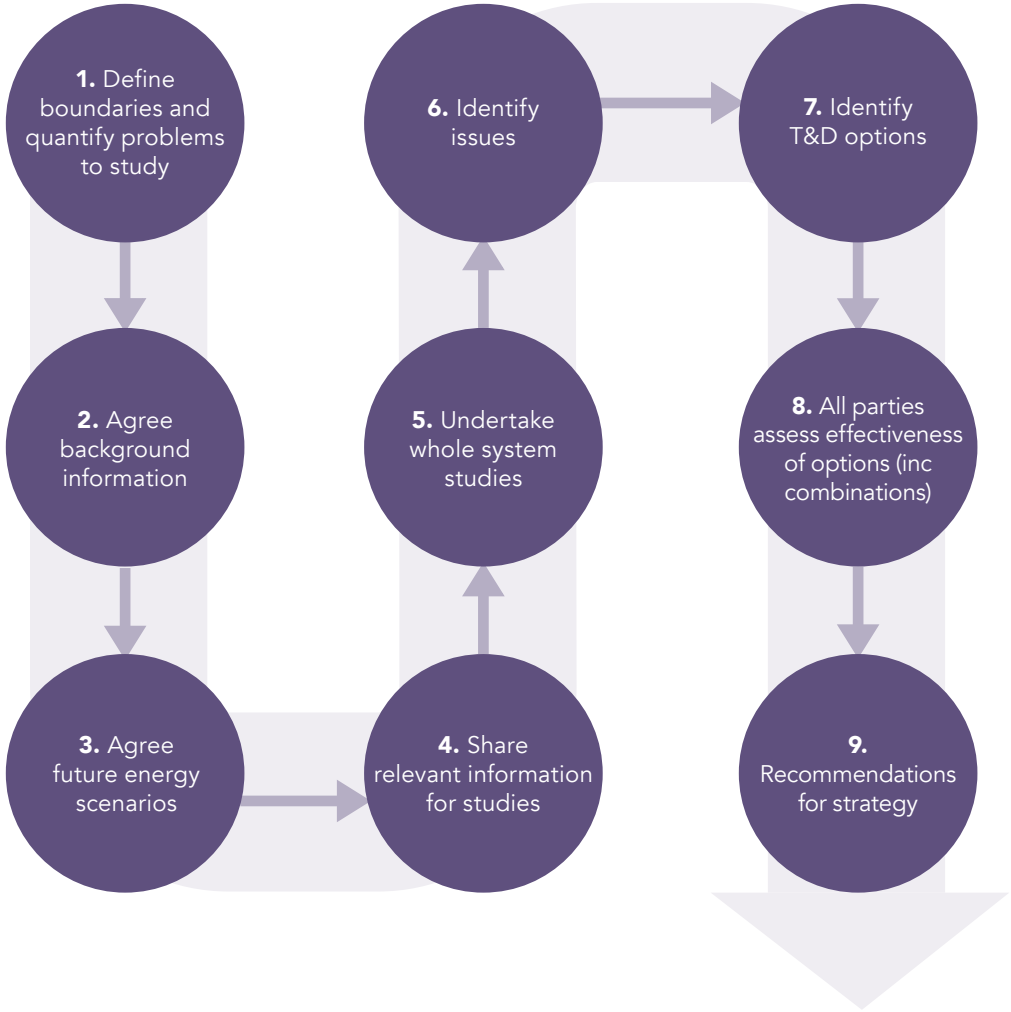
7. Whole System Planning

The Regional Development Programmes (RDPs) were set up to provide detailed analysis of areas of the network which have large amounts of Distributed Energy Resource (DER) and known transmission/distribution network issues in accommodating that DER.

The idea is to use this analysis to innovate and push the boundaries of current thinking with a "design by doing" approach to resolving the issues, pushing towards Distribution System Operator (DSO) type solutions and informing thinking for the DSO debate.

By solving a specific case study that has a pressing need to improve outcomes for customers in innovative ways, it is possible to make progress faster than the more conventional method of agreeing changes in approach at industry forums before making changes to the way the industry works. While there are risks that working in this way leads to a lack of standardisation across the GB network, this has been successfully managed by close cooperation and using the regional development programmes as case studies for the Energy Networks Association (ENA) Open Networks Project. Techniques and processes used within the RDPs will be replicated across other network areas as appropriate, resulting in innovative approaches being deployed much more rapidly.

Initially the RDPs have been set up on a project basis, but as the techniques and findings of the RDPs move into regular practice, it is envisaged that the RDP approach will continue to develop into a series of Business as Usual (BAU) developments.



> BY SOLVING A SPECIFIC CASE STUDY THAT HAS A PRESSING NEED TO IMPROVE OUTCOMES FORCUSTOMERS IN INNOVATIVE WAYS, IT IS POSSIBLE TO MAKE PROGRESS FASTER.

7. Whole System Planning

The Heat & Fleet project concept

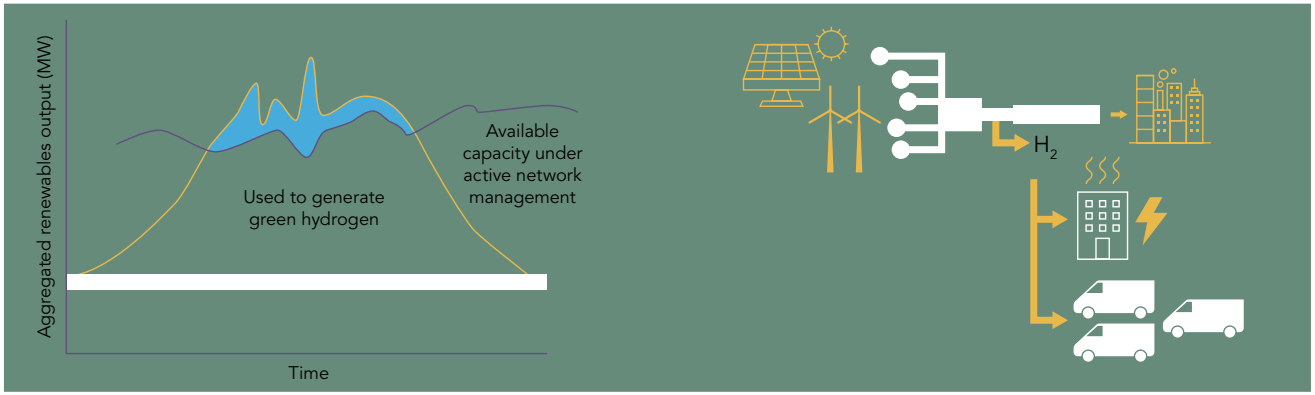
Our Hydrogen Heat and Fleet project set out to explore the use of electrolysers to generate hydrogen from excess local renewable electricity. This concept could result in less curtailment of renewable resources, and provide a highly controllable demand allowing energy storage in the form of hydrogen gas. We worked in partnership with Delta-ee to conduct detailed feasibility research to ascertain the viability of a demonstration project.

The primary aim of this project was to research the use of hydrogen electrolysers as a controllable load that could help with increasing renewable electricity output. In areas with large penetrations of renewable generation, a controllable load will increase the capacity for further generation connections and further allow for renewable output that is currently curtailed to be put to use. Two potential uses for the hydrogen generated have been identified: use as a transport fuel in hydrogen powered vehicles and; use in a fuel cell for heating a building, combined with electricity output for powering the building.

Potential project benefits

The Heat & Fleet concept could result in a number of benefits, which are also all possible project drivers:

- Less curtailment of renewable resources –maximising use and increasing efficiency of the overall network
- Reduce constraint payments for the system operator
- Provide a highly controllable demand to help with network management
- Possibly provide additional revenue to renewable generators in a post subsidy environment
- Allow for energy storage in the form of hydrogen
- Production of a low carbon fuel for transport
- Production of a low carbon fuel for heating and electricity production
- Provide an interface between the gas and electricity networks



A possible way forward

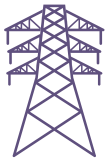
The innovative nature of the deployment, from the learning of the project, would be the use of an electrolyser for load levelling. The biggest obstacle to this at the moment is the limited number of hours per year that the cumulative output of renewables breaches the network capacity on the different parts of a distribution network.

Currently, the best economic mechanism for the hydrogen generated by an electrolyser is a vehicle fleet; a pure hydrogen fuel cell vehicle fleet constitutes the best economic case. The project learning demonstrated that to ensure a viable economic case an electrolyser would be required to operate for over 2500 hours per year.

8. Enabling Decarbonisation

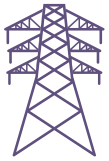
WPD is committed to supporting renewables and other generation technologies by facilitating connections to our network and reducing the time taken to connect.

Our network has seen a significant increase in distribution connected energy resources and to date there are over 187,000 sites providing generation back to the energy system.



3,889MW

Of Alternative Connection offers sent to date



398MW

Installed capacity of renewables connected in 2018

Alternative Connections

Our alternative connections suite has developed four additional options for customers seeking to connect to the grid. Timed and Import/Export limited connections are available across all WPD regions. Soft-intertrip connections are available across all regions as an interim option until we achieve full Active Network Management (ANM) roll out by 2021.

There are four variants:

ANM

This solution is the most complex, but allows for the most optimal network usage. In areas where there are multiple complex constraints affecting a number of customers over a long time period, full active network management systems will be implemented. Distributed control systems continually monitor all the limits on the network and then allocate the maximum amount of capacity to customers in that area, based on the date their connection was accepted.

Soft-intertrip

Some networks are constrained due to a single upstream asset requiring reinforcement, or a single limit being infringed under certain conditions. This solution has an on-site soft-intertrip Remote Terminal Unit which provides two normally open contacts for the customer's control system to monitor; Stage 1 and Stage 2. When both sets are open, the connection will be free of constraints. The levels of curtailment corresponding to the operation of the Stage 1 and Stage 2 contacts are defined at the planning stage.

Timed

This solution is a simple timer-based device that monitors the connection agreement with the customer, which will include some form of curtailment based on times of day. The customer's connection agreement will include an operating schedule which will define the times and levels of capacity available to them. The solution is supplied by the customer's equipment and does not require any additional investment from WPD to implement.

Export limited

This type of connection enables customers to cap their import from or export to the distribution grid. This often allows customers to connect renewable generation or storage beyond their meter whilst protecting the distribution network. Measurement and control equipment is used to automatically adjust the customer equipment to ensure they comply with their connection agreement.

9. Enabling Economic Growth

Western Power Distribution has been undertaking analysis on long term strategic studies, to better understand the potential growth in the connection of distributed generation (DG) and energy demand in all its licence areas, and how that future growth may impact on the network.

Every six months we publish a Strategic Investment Options study report on one of our four licence areas: **www.westernpower.co.uk/netstrat**

WPD's Strategic Investment Options reports detail the potential investments required at each GSP and BSP to accommodate the demand and generation forecast under WPD's system operator-aligned future energy scenarios.

Four energy scenarios: Consumer Power, No Progression, Gone Green and Slow Progression are used to identify a range of credible pathways to a decarbonised and decentralised future.

Q1&Q2 2019	EAST MIDLANDS
Q3&Q4 2019	WEST MIDLANDS
Q1&Q2 2020	SOUTH WEST
Q3&Q4 2020	SOUTH WALES

Scenarios requiring investment for West Midlands

GSP	2020				2025			
Bishops Wood			CP	GG	NP	SP	CP	GG
Bushbury							CP	GG
Bustleholm							CP	GG
Cellarhead					NP	SP	CP	GG
Feckenham	NP	SP	CP	GG	NP	SP	CP	GG
Iron Acton								
Ironbridge & Shrewsbury			CP	GG			CP	GG
Kitwell							CP	GG
Lea Marston/Hams Hall			CP	GG	NP	SP	CP	GG
Nechells	NP	SP	CP	GG	NP	SP	CP	GG
Ocker Hill							CP	GG
Oldbury								
Penn						SP	CP	GG
Port Ham/Walham			CP	GG	NP	SP	CP	GG
Rugeley			CP	GG	NP	SP	CP	GG
Willenhall				GG		SP	CP	GG

CP Consumer Power NP No Progression GG Gone Green SP Slow Progression

9. Enabling Economic Growth

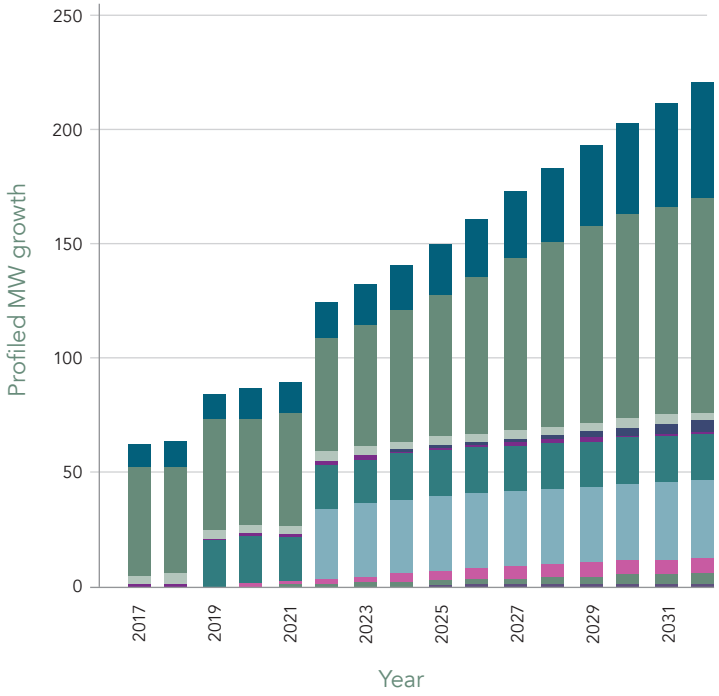
As well as providing a long term view of how we anticipate the network will develop, the data behind these assumptions has been supplied to other key stakeholders to further inform their future planning.

Our Network Strategy team has split the four WPD regions into over 260 smaller electricity supply areas and has generated growth scenario data for these areas until 2032. This includes details on installed capacities per technology type and estimated daily profiles. Already, 30% have been used by third parties to inform their energy strategies.

115

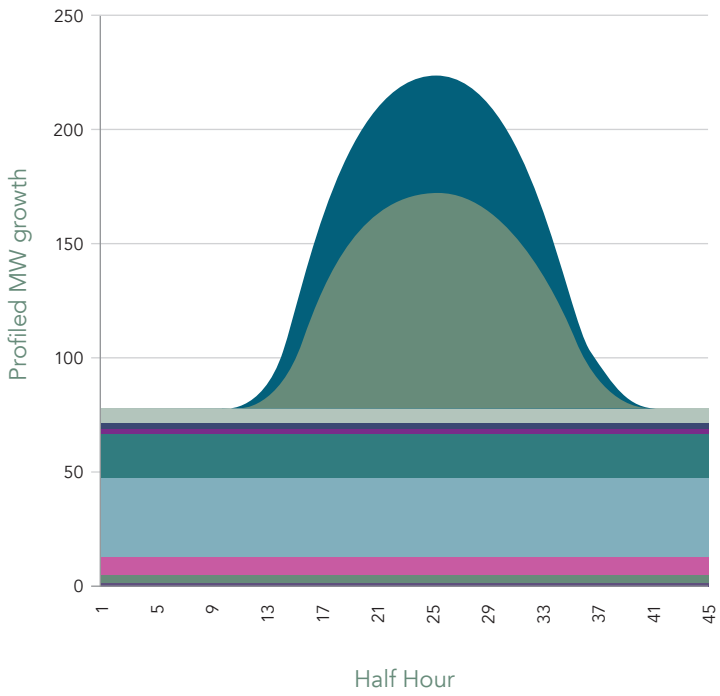
Number of areas WPD has provided future energy scenario data on to stakeholders

Generation Installed Capacity



- Solar PV – Rooftop
- Solar PV – Ground mounted
- Other generation
- Onshore wind
- Hydropower
- Gas
- Battery storage – high energy commercial & industrial
- Battery storage – generation co-location
- Battery storage – Domestic and community own use
- Anaerobic digestion

Maximum Generation Output Profile



- Solar PV – Rooftop
- Solar PV – Ground mounted
- Other generation
- Onshore wind
- Hydropower
- Gas
- Battery storage – high energy commercial & industrial
- Battery storage – generation co-location
- Battery storage – Domestic and community own use
- Anaerobic digestion

10. Communities and Localism

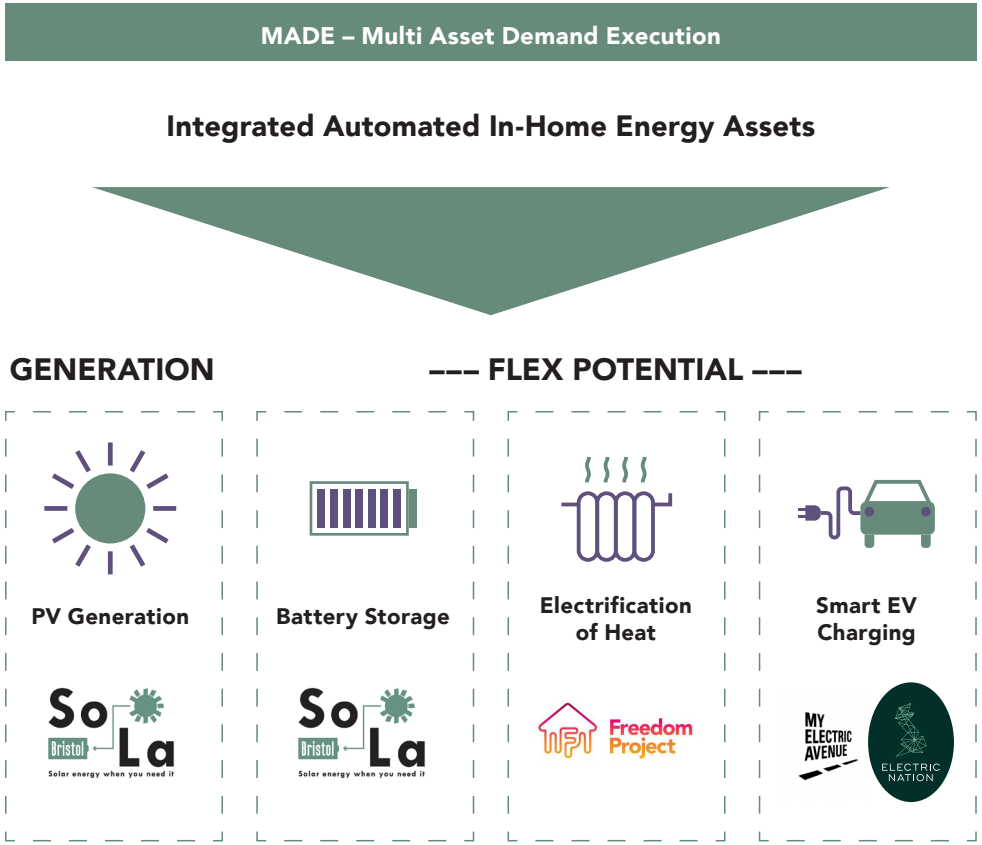
We believe it is the responsibility of large organisations like ours to play a full and active role in the communities they serve.

We are committed to working pro-actively with community energy groups and recognise that the volunteer led approach and complex nature of their projects means that community energy groups need more time and support to engage in the process of connecting to the network.

We run eight Community Energy Events every year at key locations where community energy groups can come to find out what is happening in the industry and speak to us. We have a dedicated Community Energy page with animations, guides and podcasts on topics that Community Energy groups are interested in.

Our MADE project demonstrate WPD's commitment to understanding the impact of future low carbon technologies onto community energy. MADE draws on our learning from previous community projects including SOLA Bristol, Freedom and Electric Avenue. We will show how communities and other local initiatives to be an integral part of the transition to a smarter and more flexible system.

www.westernpower.co.uk/Community-Energy



This world-first project investigates the network, consumer and broader energy system implications of high volume deployments of the combination of domestic vehicle Electric Vehicle charging with hybrid heat pump heating systems and solar PV generation and storage.

The research objective is to better understand the feasibility of managing and aggregating multiple energy assets affordably through the use of advanced algorithms to unlock value from energy markets. Through customer research we will also evaluate consumer trust in new technology that is taking greater levels of EV charging, heating system control, and design appropriate user interfaces and information systems to help drive adoption.

A 5 home technology trial in South Wales will be used to validate the modelled learning.

The 18 month project will be delivered by PassivSystems who will be supported by Wales and West Utilities, Everoze, Imperial College London and Delta EE.

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