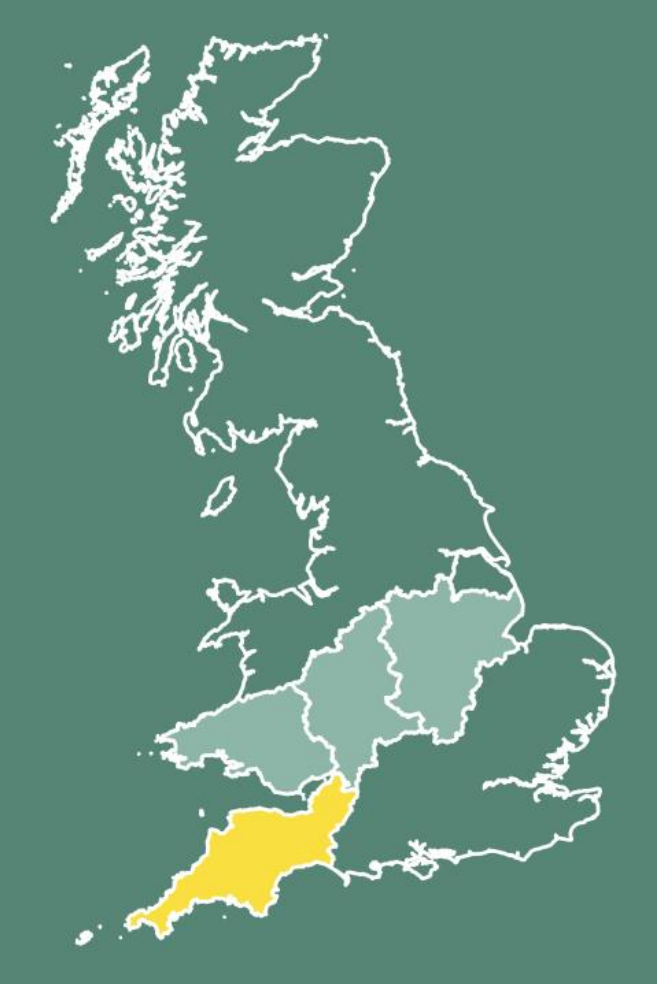
Welcome

The webinar will begin shortly after 2pm

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales



Shaping Subtransmission

South West
2018 studies

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Agenda

- Welcome & Questions
- Study Objectives
- South West Background
- Scenarios and Modelling
- Results
- Next Steps
- Looking to the Future

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Objectives

- Forecast growth of demand and generation over four economic and environmental scenarios;
- Assess the ability of the existing network to accommodate new demand and generation connections under those scenarios, without exceeding thermal and voltage limits;
- Assess options for reinforcement;
- Provide stakeholders with advance notice of likely constraints; and
- Provide recommendations for strategic ‘low regret’ investment.

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Background

- Network designed for demand
- Current maximum demand around 2.6GW and minimum demand below 0.8GW
- Large growth of photovoltaic

	Connected [MVA]	Accepted [MVA]	Offered [MVA]	Enquired [MVA]	Total [MVA]
Energy Storage	20	190	250	2	**461**
Photovoltaic	1,300	96	702	121	**2220**
Wind	309	8	20	0	**337**
All Other Generation	625	402	313	90	**1430**
Grand Total	**2,255**	**697**	**1284**	**213**	**4448**

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Background

- Significant usage of capacity by connected and contracted generation in South West
- Peak reverse power and high voltage limitations all coincide due to prevalence of photovoltaic installations
- Peak forward power limitations coincide at winter peak due to heating and lighting demands
- Widescale reengineering of the substransmission network has enabled additional capacity to be released for generation.
- Statement of Works (SoW) process have caused uncertainty and difficulties for generation customers to commit investment in their projects
- The cost of the generation technology continues to go down and, excluding significant grid reinforcement costs, price parity for large (>10MW) solar could be reached by 2020. There is still significant interest in PV developments.

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Clean Growth Strategy (BEIS)

AMBITION:

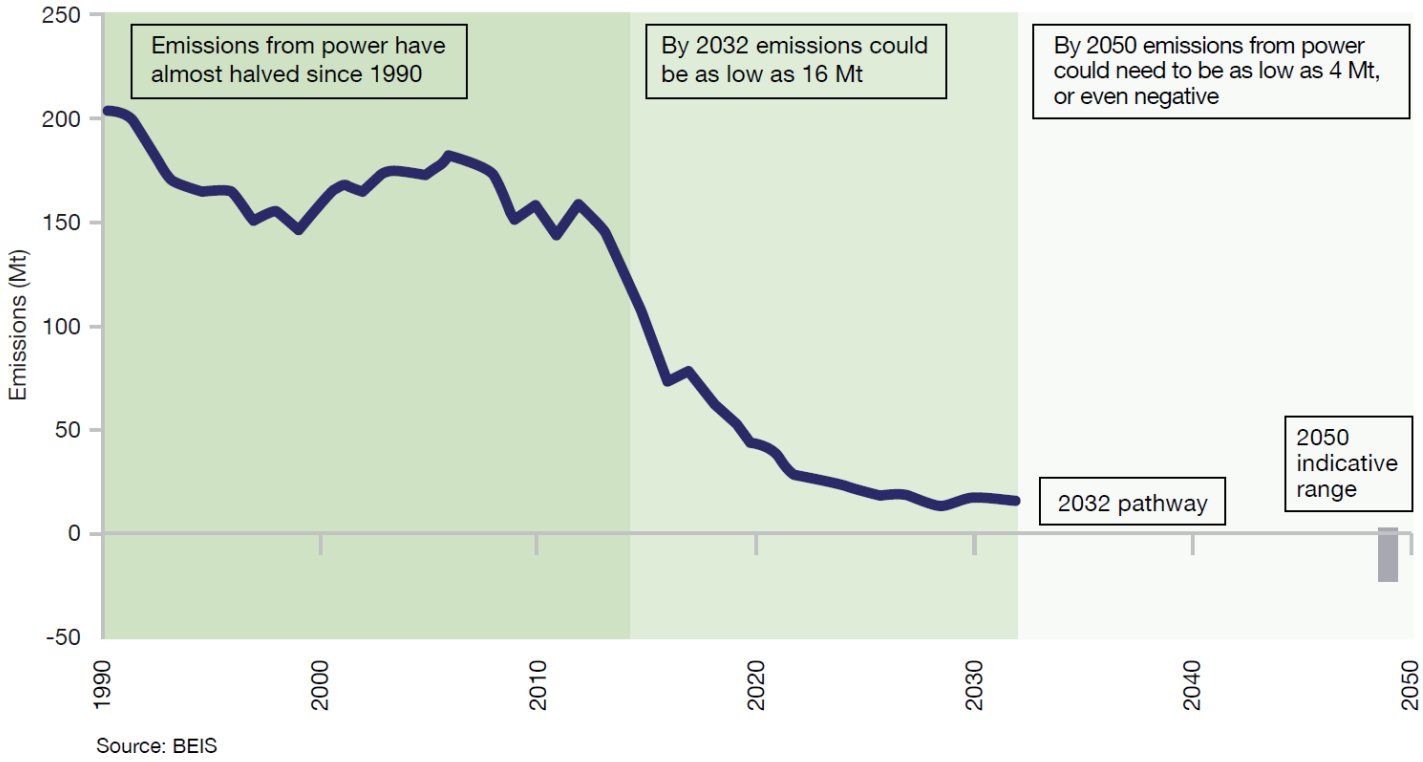
We want a diverse electricity system that supplies our homes and businesses with secure, affordable and clean power. That means developing low carbon sources of electricity that are both cheap and clean, taking into account wider system impacts for all sources of generation. It also means upgrading our electricity system so it is smarter (using data to provide greater control), more flexible (providing energy when it is needed) and takes advantage of rapidly developing technologies such as energy storage.

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Clean Growth Strategy (BEIS)

Figure 25: Actual and projected power sector emissions, taking into account the clean growth pathway, 1990-2050



Source: BEIS

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Scenarios

- Growth of:
  - Domestic, industrial and commercial demand
  - Distributed generation (DG)
  - Heat pumps (HPs)
  - Electric vehicles (EVs)
  - Battery storage

  in South West forecast by Regen from 2018 to 2032
- Four scenarios corresponding to NG FES (2017):
  - Two Degrees
  - Consumer Power
  - Slow Progression
  - Steady State

Graphic from National Grid's Future Energy Scenarios in five minutes, July 2017

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Scenarios – methodology

Stage 1
Current baseline

Stage 2
Pipeline projection
Near term
(where possible to 2020)

Stage 3
Growth scenarios
Longer term (to 2030)

Current data
Use and validate existing DG capacity and demand data to set baseline

Pipeline projection
DG projects w/connection agreement and in planning system
Growth estimate for small scale FIT and new projects
Demand projection

Long term energy potential
- Long term energy assessment
- Developable resource
- Market Assessment
- Demographics
- New technology potential

Analysis by:
1) Technology type
2) BSP Areas
3) GIS mapping
4) Historic growth trend

Constraints/ factors:
1) Grid constraints
2) Policy - RO/CFD/FIT cap and subsidy
3) Planning system
4) Technology (TRL)

Apply future energy growth scenarios factors:
1) Gone Green
2) Consumer Power
3) Slow Progression
4) No Progression

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

F Route

In March 2015, we announced that due to the significant growth in acceptances for DG connection to the network it had reach a point where critical circuits (F-route) at the boundary between the South West peninsula and the main interconnected transmission network had reached the limit of its capacity. This part of the 132kV network is due to be substantially reconfigured as part of the planned transmission works for the connection of Hinkley Point C.

In 2017 works were completed to reconfigure and split the F-route, with new 132kV switchgear and connections at Churchill BSP. This brought forward a small part of the works that will be needed to facilitate the transmission works associated with the connection of Hinkley Point C power station.

WESTERN POWER DISTRIBUTION

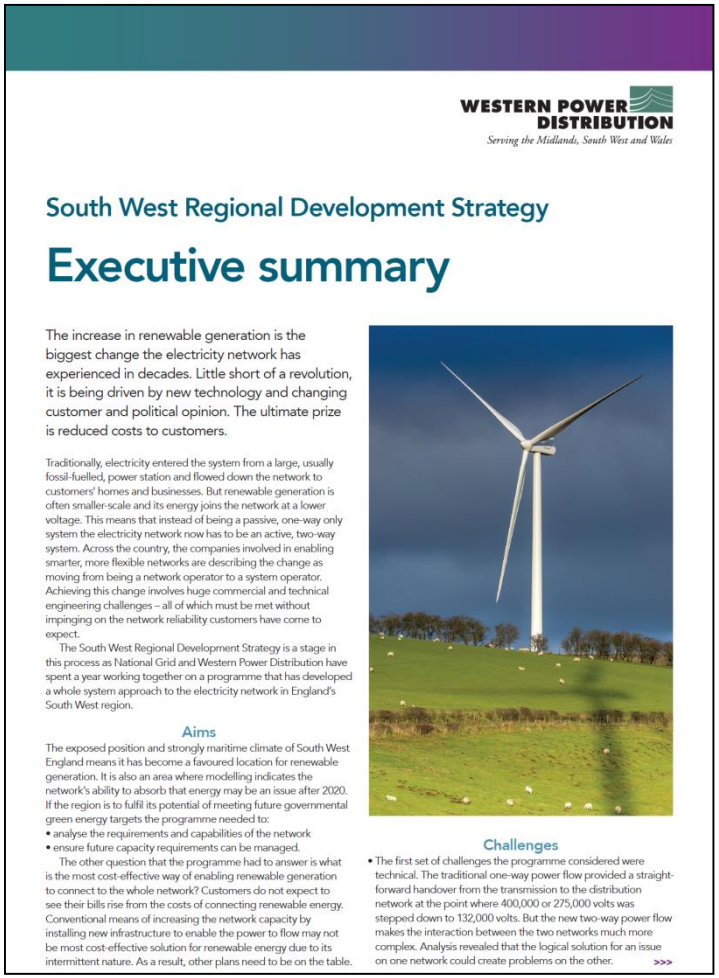
Serving the Midlands, South West and Wales

Regional Development Plan

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.

- Design by doing
- Demonstrates benefits of DSO operations
- Whole system studies for 3GW @ 2020, 4GW @ 2025, 5GW @ 2030
- CBA of multiple network investment options
- Regional Strategy to implement recommendations

The South West peninsular was chosen due to the abundance of potential renewable resources and the recognised limitations in network export capacity across both transmission and distribution networks



WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

South West Regional Development Strategy

Executive summary

The increase in renewable generation is the biggest change the electricity network has experienced in decades. Little short of a revolution, it is being driven by new technology and changing customer and political opinion. The ultimate prize is reduced costs to customers.

Traditionally, electricity entered the system from a large, usually fossil-fuelled, power station and flowed down the network to customers' homes and businesses. But renewable generation is often smaller-scale and its energy joins the network at a lower voltage. This means that instead of being a passive, one-way only system the electricity network now has to be an active, two-way system. Across the country, the companies involved in enabling smarter, more flexible networks are describing the change as moving from being a network operator to a system operator. Achieving this change involves huge commercial and technical engineering challenges – all of which must be met without impinging on the network reliability customers have come to expect.

The South West Regional Development Strategy is a stage in this process as National Grid and Western Power Distribution have spent a year working together on a programme that has developed a whole system approach to the electricity network in England's South West region.

Aims

The exposed position and strongly maritime climate of South West England means it has become a favoured location for renewable generation. It is also an area where modelling indicates the network's ability to absorb that energy may be an issue after 2020. If the region is to fulfil its potential of meeting future governmental green energy targets the programme needed to:

- analyse the requirements and capabilities of the network
- ensure future capacity requirements can be managed.

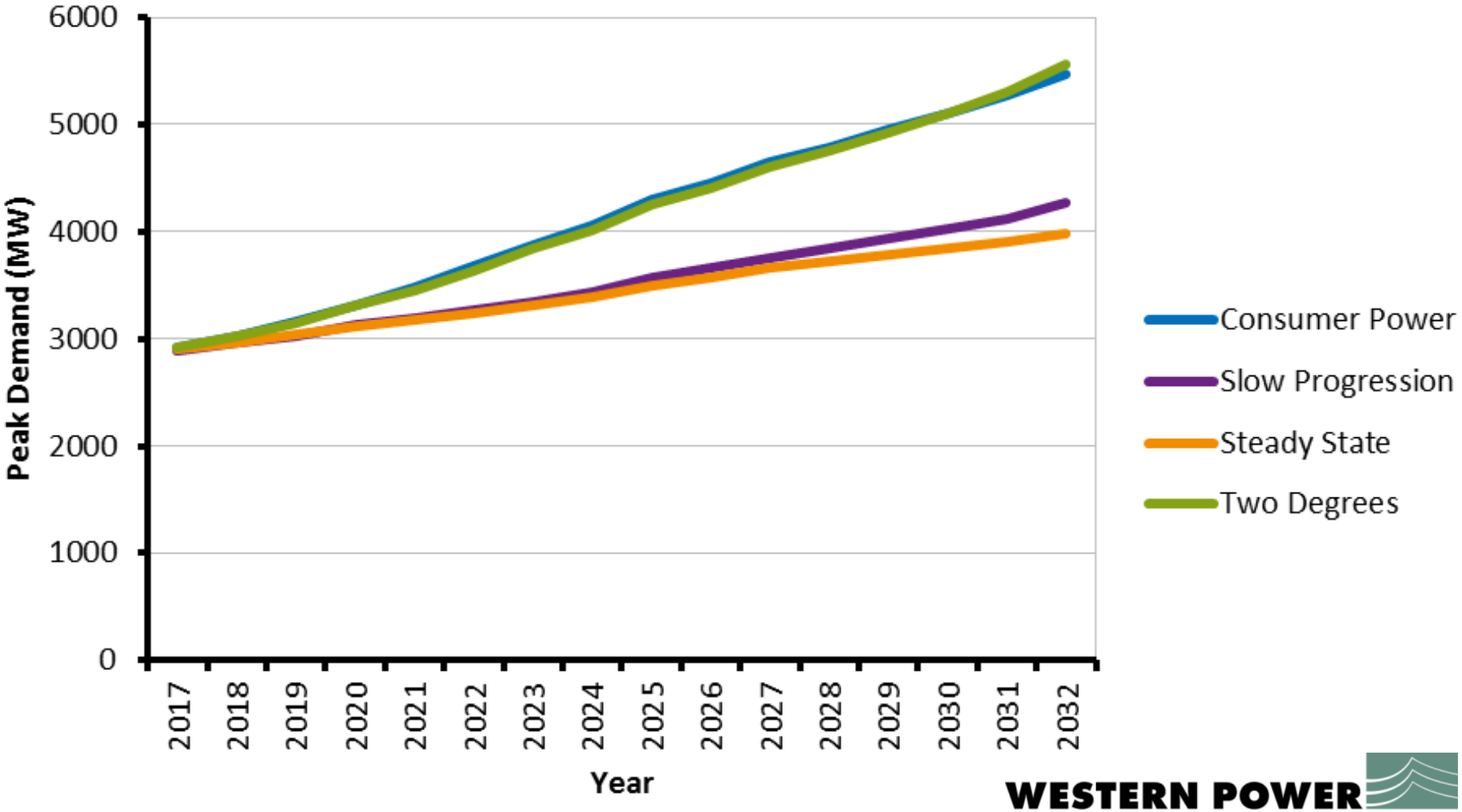
The other question that the programme had to answer is what is the most cost-effective way of enabling renewable generation to connect to the whole network? Customers do not expect to see their bills rise from the costs of connecting renewable energy. Conventional means of increasing the network capacity by installing new infrastructure to enable the power to flow may not be most cost-effective solution for renewable energy due to its intermittent nature. As a result, other plans need to be on the table.

Challenges

- The first set of challenges the programme considered were technical. The traditional one-way power flow provided a straight-forward handover from the transmission to the distribution network at the point where 400,000 or 275,000 volts was stepped down to 132,000 volts. But the new two-way power flow makes the interaction between the two networks much more complex. Analysis revealed that the logical solution for an issue on one network could create problems on the other. >>>

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

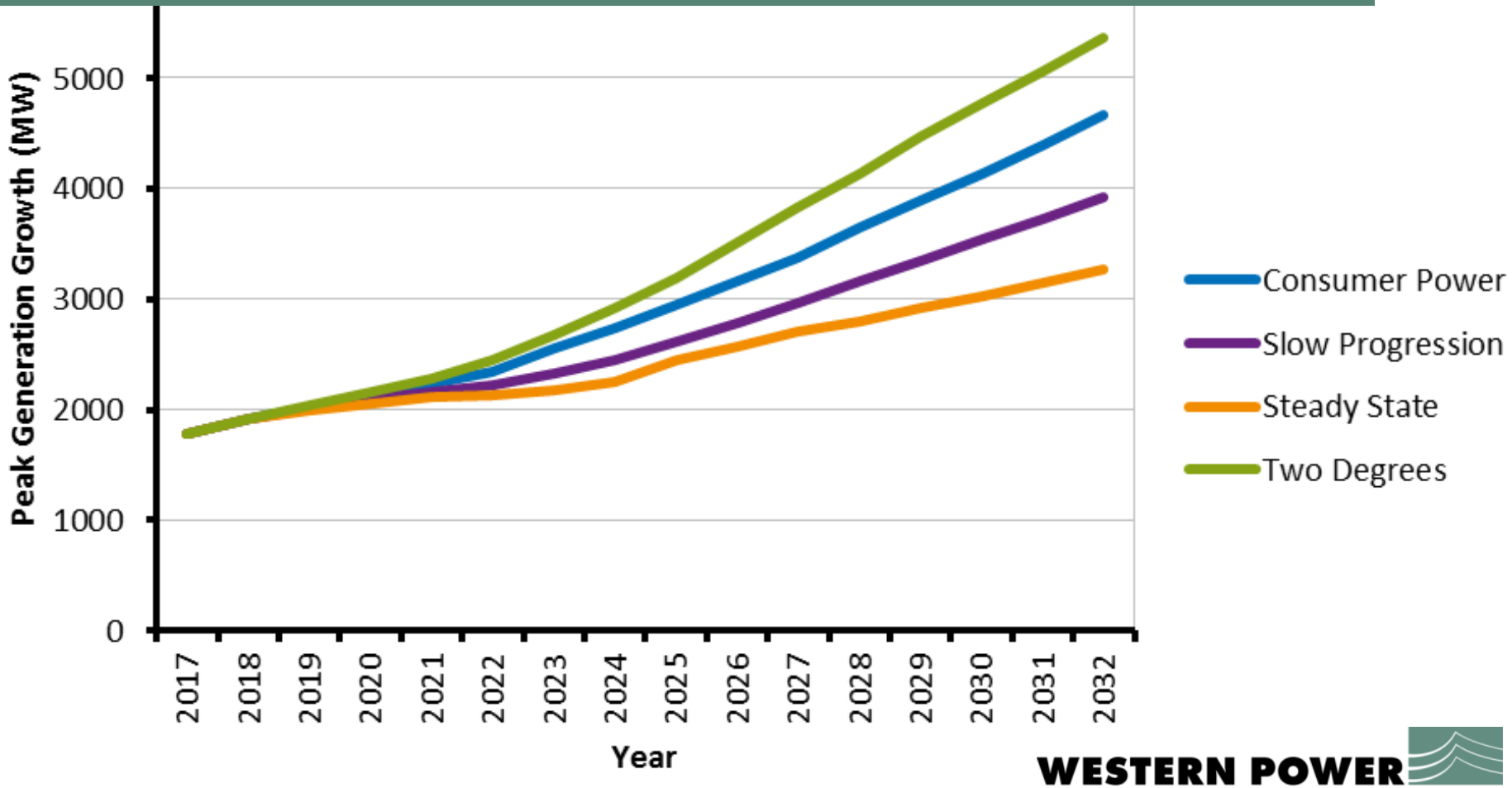
Scenarios – Demand Growth



WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Scenarios – Generation Growth

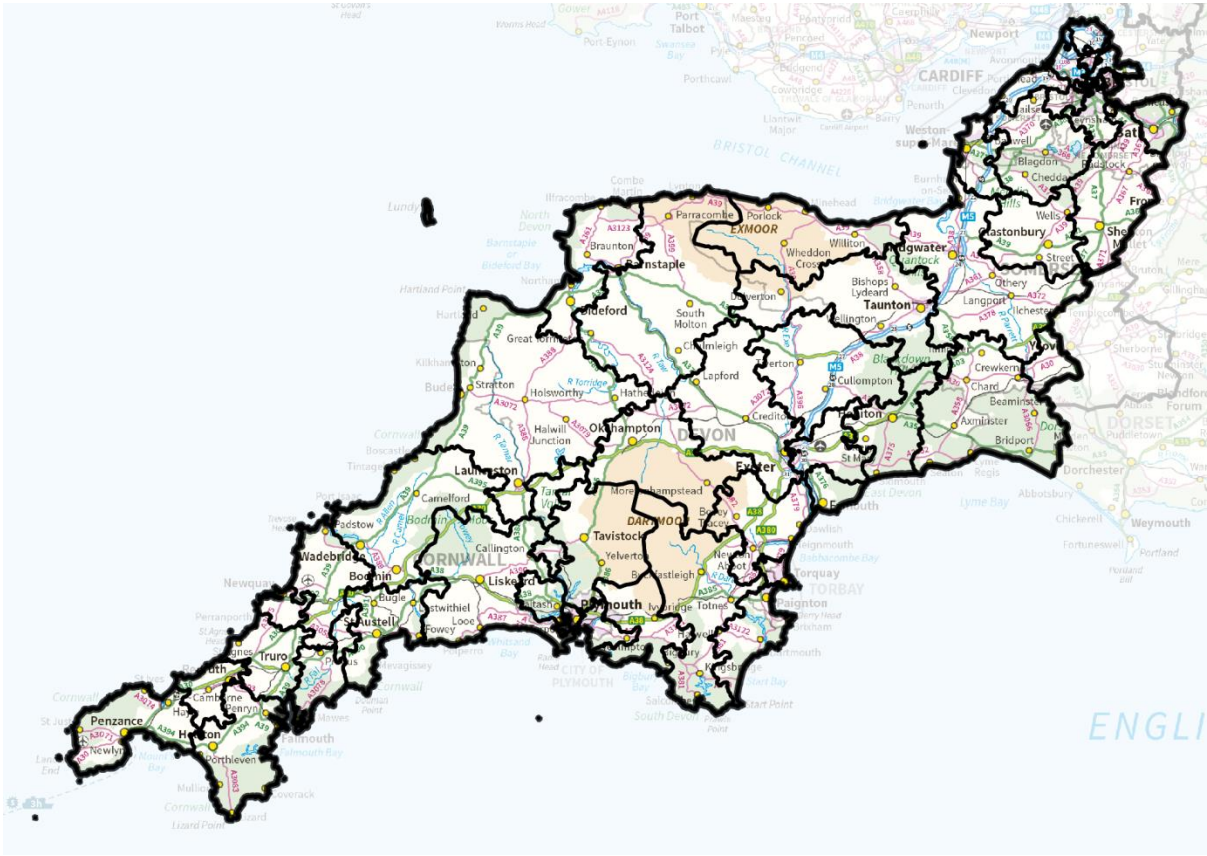


WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Network modelling

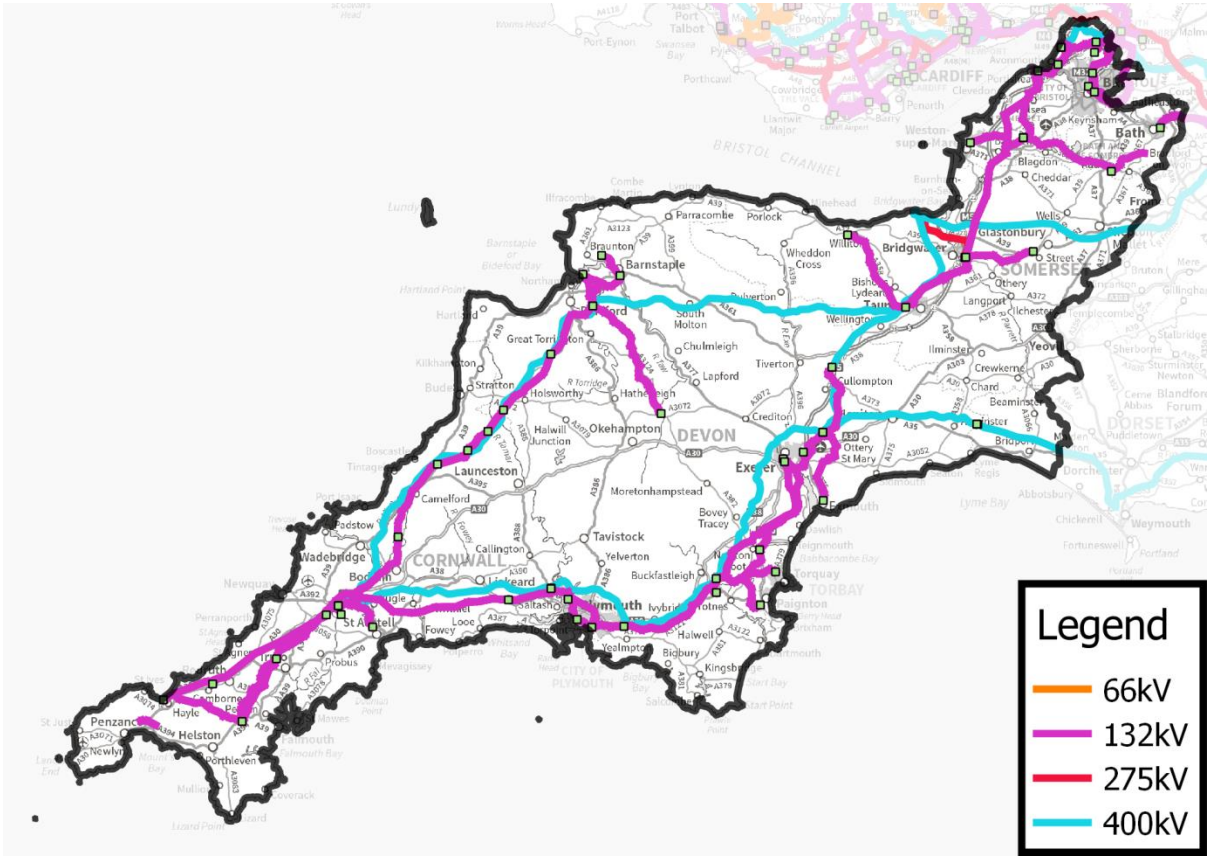
- South West divided into Electricity Supply Areas (ESAs):
  - 132/kV BSPs
  - 132/11kV BSPs
  - 132kV customers
- Scenarios developed at ESA granularity to provide link between geographical position of developments and WPD's network



WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Network modelling

- Focus on the subtransmission network consisting of:
  - GSPs (400 or 275kV to 132kV)
  - 132kV network
  - BSPs (132/33kV and 132/11kV)
- Subtransmission reinforcement often protracted and expensive; requires long-term planning



WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Network modelling

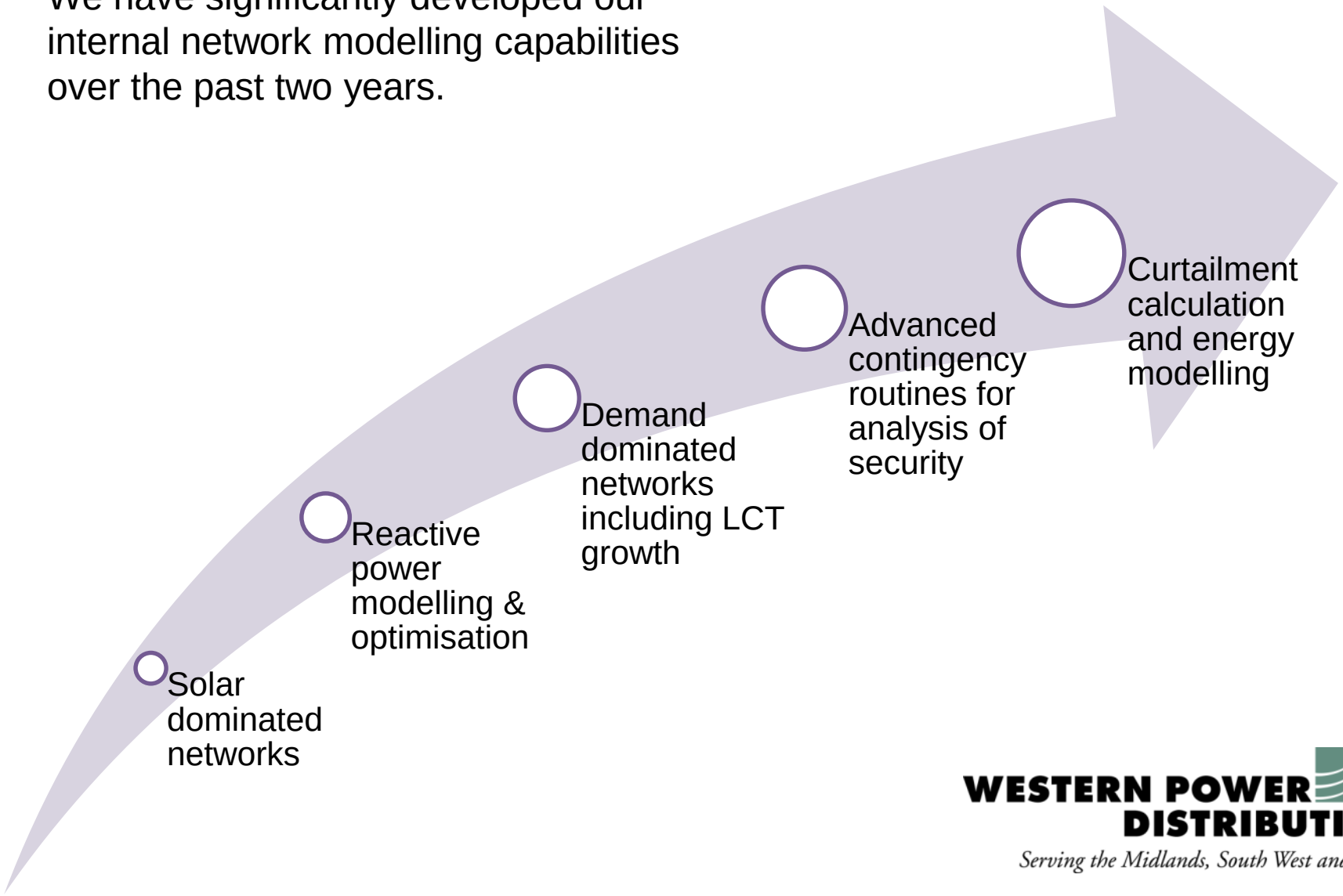
- Traditional analysis has focused on the expected peak/minimum demand conditions. This study modelled each half-hour for:
  - Winter Peak Demand, with minimum coincident generation,
  - Autumn Peak Demand with minimum coincident generation,
  - Summer Peak Demand with minimum coincident generation, and
  - Summer Peak Generation with minimum coincident demand.
- Intact network, first-circuit outages, second-circuit outages and busbar outages analysed
- Profiles of generation/demand were determined using a combination of historical data logging data modified for technology additions according to the scenario
- Network automation such as intertripping and overload management was modelled
- Analysis was undertaken for the baseline of 2018 and then the scenarios for 2020, 2025 and 2030

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

New Modelling Techniques

We have significantly developed our internal network modelling capabilities over the past two years.



WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Hinkley Point C

By the end of 2024, it is expected that the works on WPD's network to enable the connection of Hinkley Point C nuclear power station will be complete. These works entail a major reconfiguration of the 132kV networks in Somerset and the Severnside area to make way for a new 400kV route from Hinkley Point to Seabank. Works affecting WPD's network include:

- The removal of the 132kV F-route and G-route from Bridgwater GSP to Avonmouth BSP;
- The undergrounding of parts of various other 132kV routes in the area;
- Reconfiguration of the 132kV circuits at Churchill BSP;
- The commissioning of a second SGT at Taunton GSP;
- The addition of a third independent 400kV circuit and removal of one SGT from Seabank GSP, leaving two SGTs;
- The commissioning of a new GSP at Sandford (4km south west of Churchill BSP) with two SGTs, to be operated in parallel with Seabank GSP at 132kV;
- The conversion of Bridgwater GSP from 275kV infeed to 400kV infeed. This reconfiguration will resolve the issue of Hinkley Point station demand fed via WPD network; and
- The replacement of switchgear at several substations to prevent fault level overstressing.

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Results Overview

Demand results at a glance

Table 1: Summary of demand-driven network deficiencies by year, scenario and GSP group

GSP Group	2020				2025			
Melksham (WPD)								
Iron Acton	SS	SP	CP	TD	SS	SP	CP	TD
Seabank (& Sandford)	SS	SP	CP	TD	SS	SP	CP	TD
Bridgwater & Taunton	SS	SP	CP	TD	SS	SP	CP	TD
Abham, Exeter & Landulph	SS	SP	CP	TD		SP	CP	TD
Alverdiscott & Indian Queens	SS	SP	CP	TD	SS	SP	CP	TD

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Results Overview

Generation results at a glance

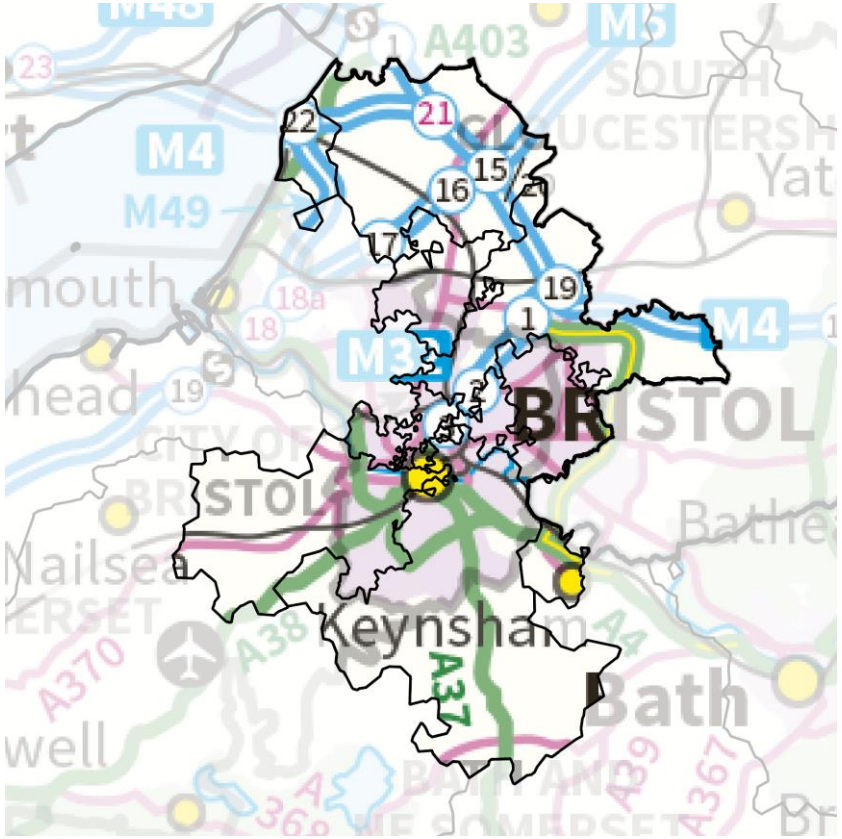
Table 1: Summary of generation-driven network deficiencies by year, scenario and GSP group

GSP Group	2020	2025
Melksham (WPD)		
Iron Acton		SS SP CP TD
Seabank (& Sandford)		
Bridgwater & Taunton	SS SP CP TD	CP TD
Abham, Exeter & Landulph	SS SP CP TD	SS
Alverdiscott & Indian Queens	SS SP CP TD	SS SP CP TD

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

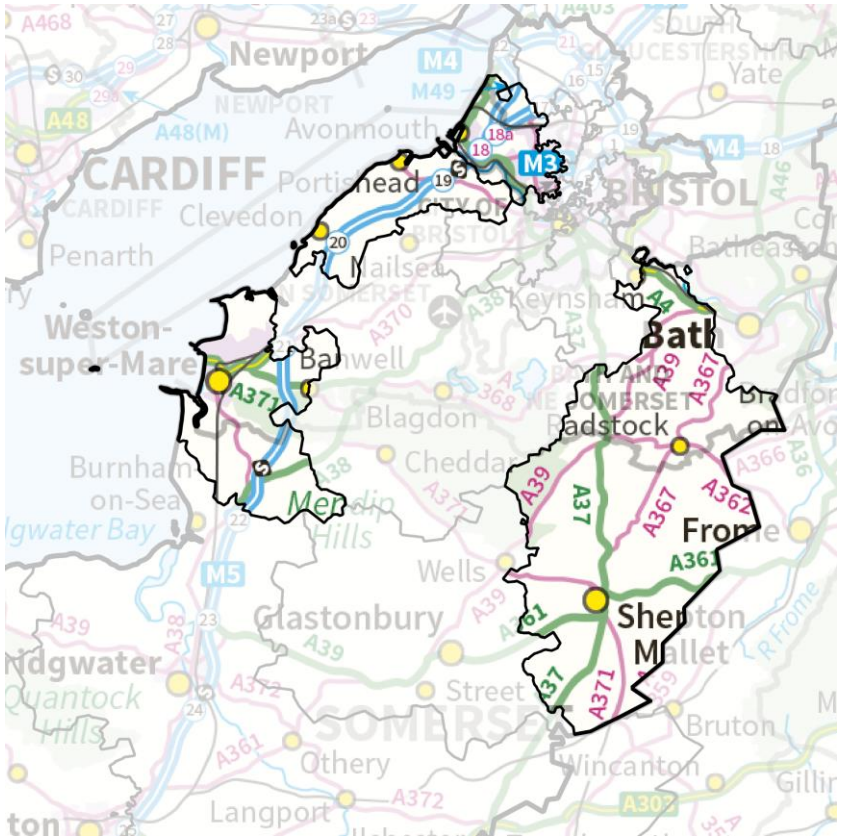
Results – Iron Acton GSP



- Demand-driven reinforcement
- Hotspots:
  - SGT Capacity (demand)
  - Feeder Road BSP (demand)
- Proposed:
  - Reserve Bus Section breakers, or
  - Alternative network reconfiguration, or
  - Larger SGTs at Iron Acton
  - Enhanced ratings, or
  - Flexibility services, or
  - Load management schemes

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

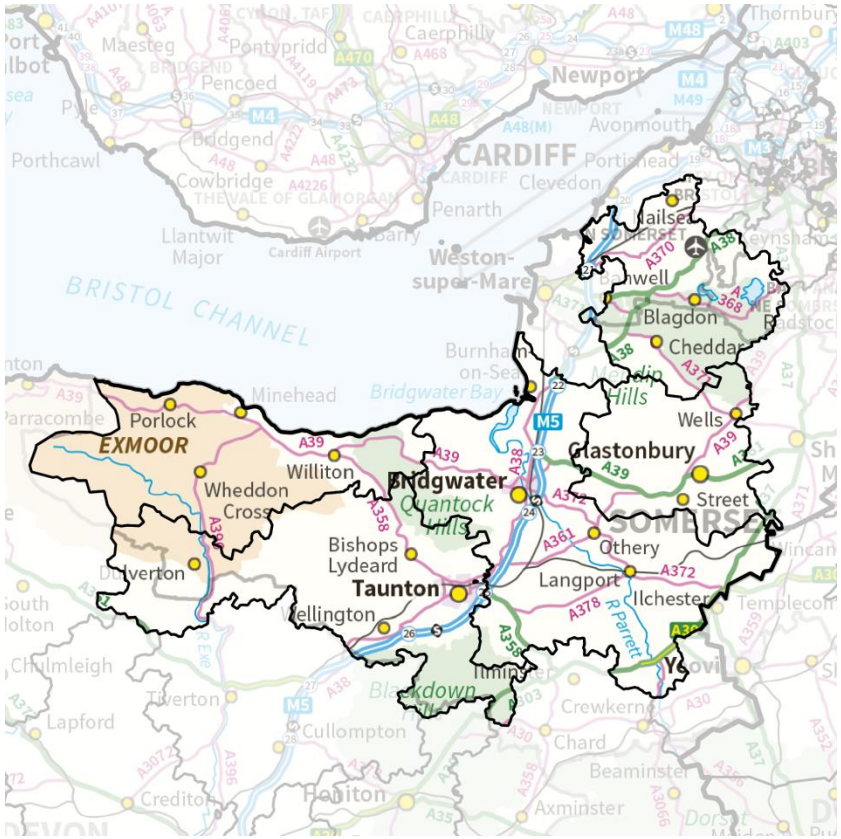
Results – Seabank GSP



- Demand-driven reinforcement
- Hotspots:
  - Seabank GSP
  - Avonmouth/Weston 132kV
- Ongoing:
  - Hinckley Point C works
- Proposed:
  - Demand transfer out, or
  - Flexibility services
  - Transferral of Kingsweston Primary

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

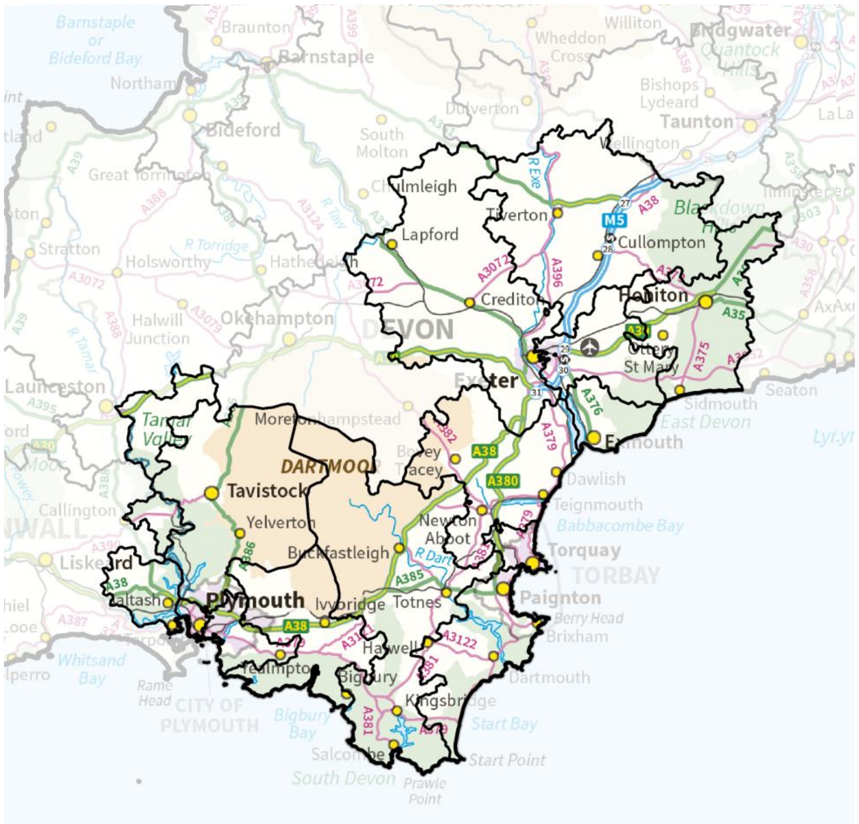
Results – Bridgwater/Taunton GSPs



- Demand and Generation-driven reinforcement
- Hotspots:
  - SGT capacity
  - Bridgwater/Street BSP group
- Proposed:
  - Bring forward Taunton SGT1 from 2021
  - Short term ratings and post-fault load transfers
  - Mixture of:
    Additional GT, Network reconfiguration and/or flexibility services

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

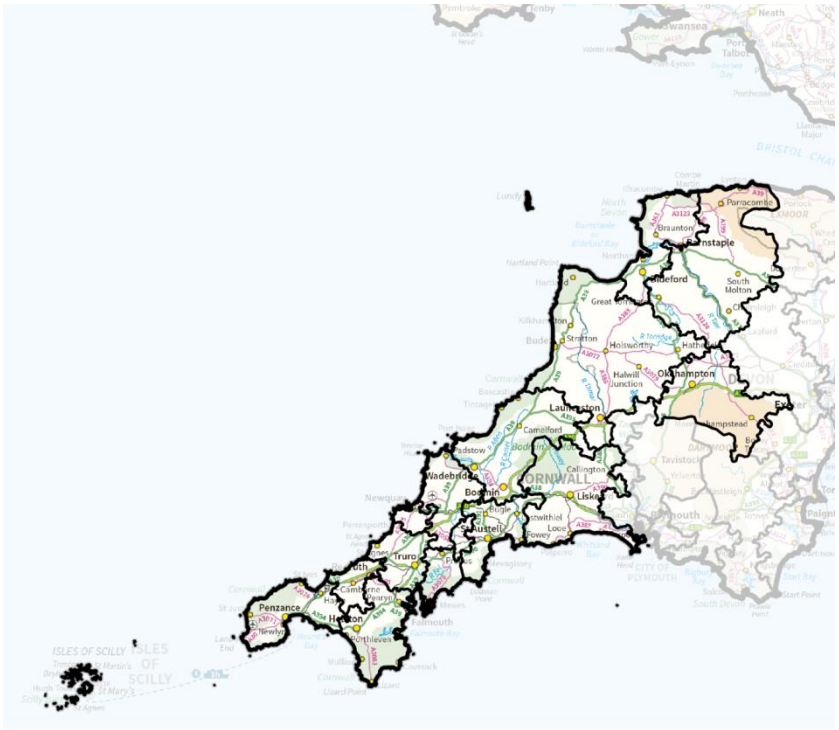
Results – Abham, Exeter & Landulph GSPs



- Demand and Generation-driven reinforcement
- Hotspots:
  - SGT group capacity
- Proposed:
  - **Additional section breakers at Plymouth**
  - **Additional GT at Plymouth**
  - **Reconductor H-route**
  - **Overlay Totnes to Abham CCTs**
  - **Network reconfiguration**
  - Confirmation of ratings (inc short term limits) with SO
  - Reconfiguration for load sharing
  - Flexibility Services

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Results – Alverdiscott/I-Q GSP



- Demand and Generation-driven reinforcement
- Hotspots:
  - SGT capacity at Alverdiscott
  - East Yelland BSP GTs
- Ongoing:
  - Active Network Management
- Proposed:
  - Improve ratings suite to minimise curtailment
  - Extend ANM where required
  - Flexibility Services
  - Conventional reinforcement where economic

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Results – Summary

- Network reinforcements are driven by both demand and generation growth
- Most networks will need some intervention, possibly as soon as 2020
- Some networks will remain untouched
- Reinforcements identified will need to be implemented in line with the uptake trajectory for new demand
- Some scenarios heavily dependant on adjacent flows from other network operators or licence areas. Whole system studies are required to ensure least cost solutions are found.

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Next Steps

- This strategic work has identified the generation and demand growth ‘trigger points’ on our network where action needs to be taken
- Some no or low cost actions can be taken now to improve our operability and we will be putting these in progress
- Many of the growth trigger points are anticipated in the next 5 years, but actual trigger date will depend on actual growth out-turn
- Where the need for intervention is identified, we will be signposting these areas for flexibility requirements
- Expressions of interest for these areas will preceed reinforcement where flexibility is likely to be most economic

www.westernpower.co.uk/signposting

www.flexiblepower.co.uk

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Looking to the Future

- WPD has updated its DSO Strategy document following customer and stakeholder feedback: https://www.westernpower.co.uk/About-us/Our-Business/Our-network/Strategic-network-investment/DSO-Strategy.aspx

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Looking to the Future

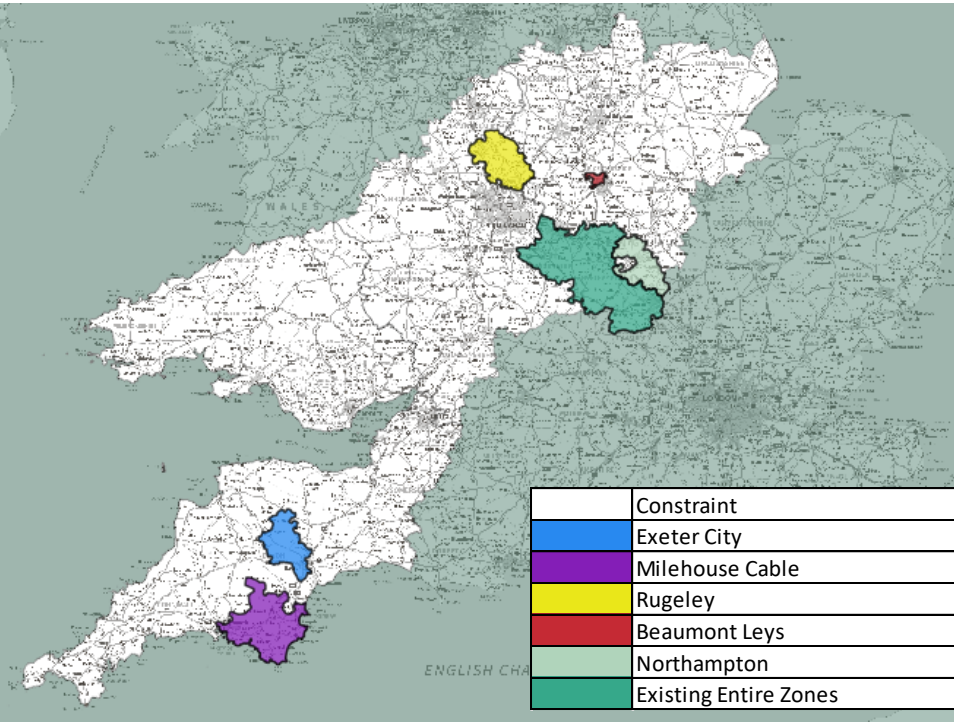


Figure 1: Overview Map of flexibility zones

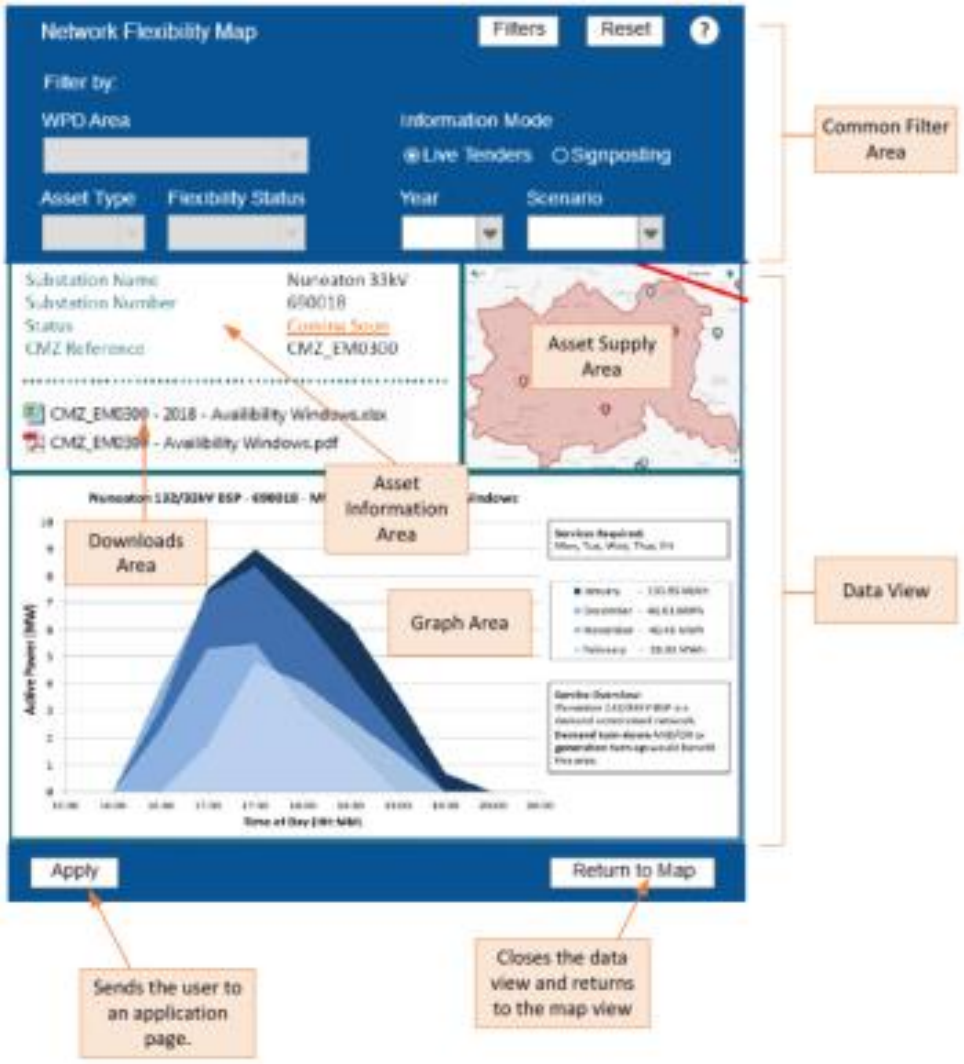
- Rolling out flexibility services across WPD
- Marketed as Flexible Power
- 3 new DSR services
  - Secure
  - Dynamic
  - Restore
- Pre and Post Fault constraint resources
- 14 Constraint Managed Zones (CMZs) in 2017
- 18 CMZs in 2018
- Over 400MWs of interest
- Contracts awarded

Flexible Power
By Western Power Distribution

www.flexiblepower.co.uk

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Looking to the Future



Using a similar functionality to our network capacity map, our network flexibility map is publically available on our website:

www.westernpower.co.uk/signposting

This displays information on:

- Geographic supply area
- MW peak and length for availability
- Estimated MWh utilisation
- Months applicable
- Days applicable
- Raw data downloads

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Summary

- This is the first of the second round of Strategic Investment Options studies.
- Significant envelope of potential change in generation and demand assessed and issues arising and potential solutions identified
- WPD is working hard to deliver a secure and economic system
- Demonstrates WPDs commitment to whole system network studies across transmission and distribution system and network operators
- We will continue to undertake these studies on a two year rolling window for the future as business as usual
- This information helps us begin to consider annual energy requirements as well as local power requirements
- Flexibility from DER can and will help us operate our network
- ENA's Open Networks project will bring consistency with other DNOs in providing this level of information to stakeholders

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Any questions?

If you have any questions, please use GoToWebinar's chat feature to ask them now.

What else can we do/should we do?

Are we right to align to National Grid FES?

Should we remove the contribution to peak demand from energy storage?

What other information can we share?

Any missing stakeholders?

Are consortium approaches for strategic reinforcement still valid?

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Further Collaboration

All our reports, webinars and presentations are published online at:
http://www.westernpower.co.uk/netstrat

If you have any questions in relation to WPD's Network Strategy work, please contact WPD on the details below:

Email: wpdnetworkstrategy@westernpower.co.uk

By post:
Network Strategy Team
Western Power Distribution
Feeder Road
Bristol
BS2 0TB

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales