Shaping Subtransmission to 2030

West Midlands
2017 studies

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Agenda

- Welcome & Questions
- Study Objectives
- West Midlands Background
- Scenarios and Modelling
- Results
- Recommendations
- Looking to the Future

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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 ‘low regret’ investment.

Background

- Network designed for demand
- Current maximum demand around 4.6GW and minimum demand below 1.5GW
- Large growth of energy storage in West Midlands:

	Connected [MVA]	Accepted [MVA]	Offered [MVA]	Enquired [MVA]	Total [MVA]
Energy Storage	3	652	1,189	77	**1,920**
Photovoltaic	590	125	22	3,440	**4,178**
Wind	48	0	0	0	**48**
All Other Generation	1,039	1,201	493	41	**2,775**
Grand Total	**1,681**	**1,978**	**1,704**	**3,559**	**8,921**

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Background

- Much of the West Midlands infrastructure was originally installed for large heavy industry, which has reduced in the previous decades.
- Distributed generation, in some of the more rural areas, has taken the network to capacity, due to thermal and voltage limitations
- Availability of distribution capacity is good across most of the region
- 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.

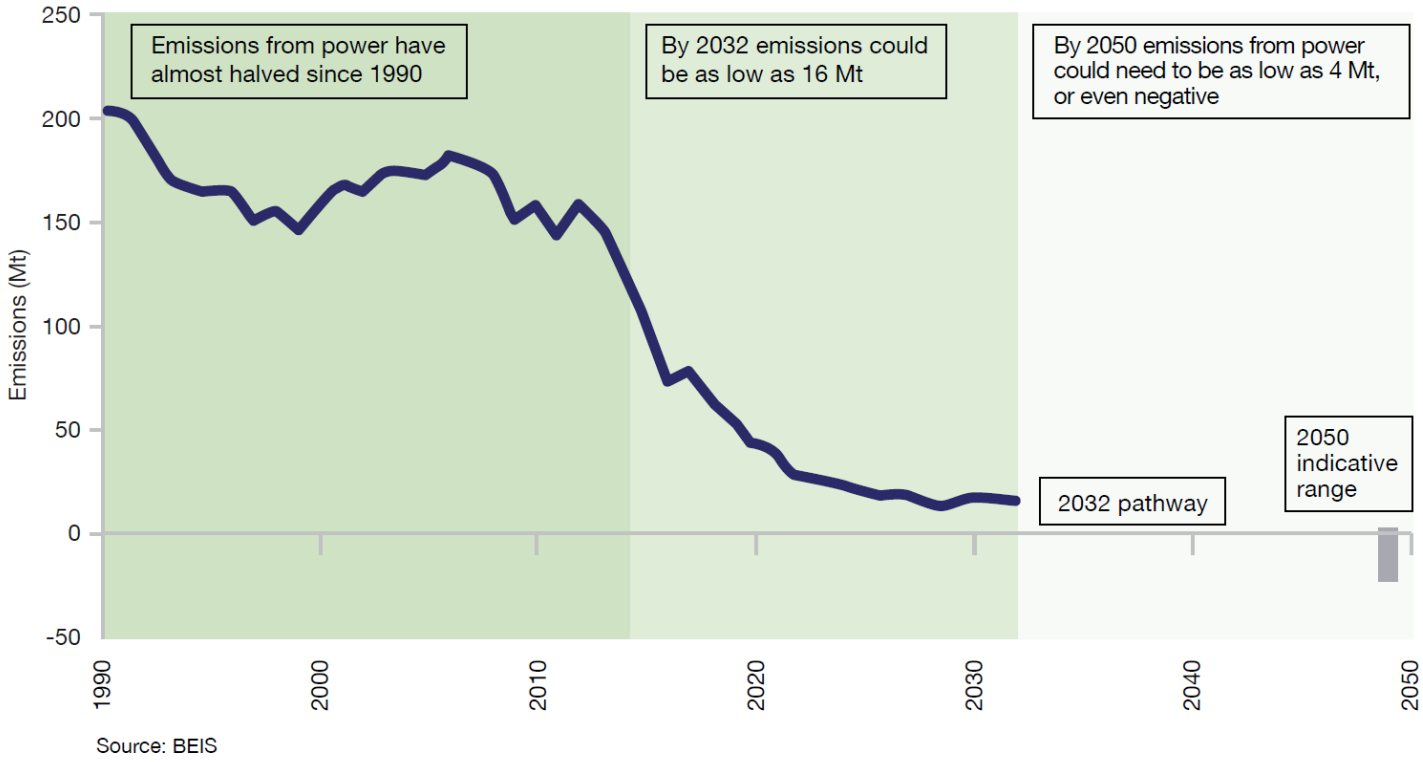
Clean Growth Strategy (BEIS)

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.

Clean Growth Strategy (BEIS)

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



Source: BEIS

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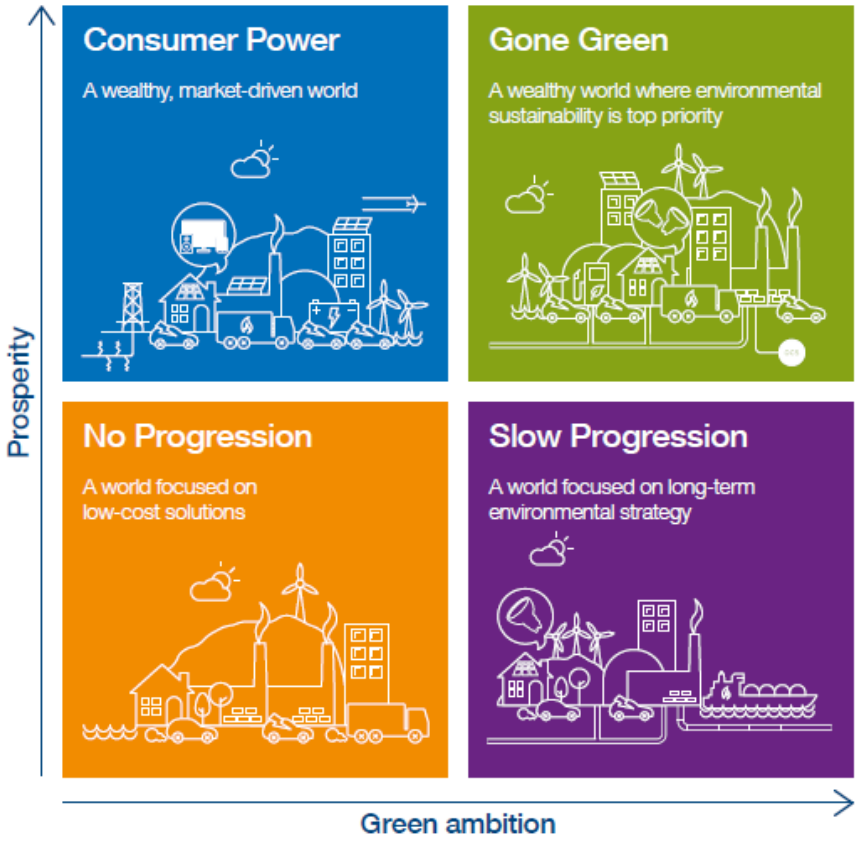
Scenarios

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

  in West Midlands forecast by Regen SW from 2017 to 2030
- Four scenarios corresponding to NGT FES:
  - Gone Green
  - Consumer Power
  - Slow Progression
  - No Progression



Graphic from National Grid's Future Energy Scenarios in five minutes, July 2016

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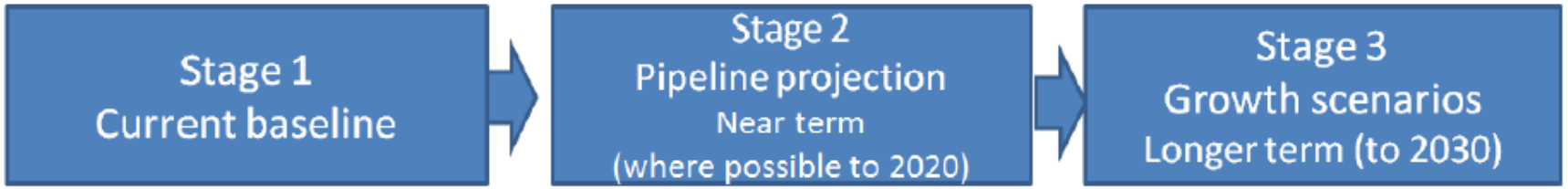
Scenarios – methodology



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

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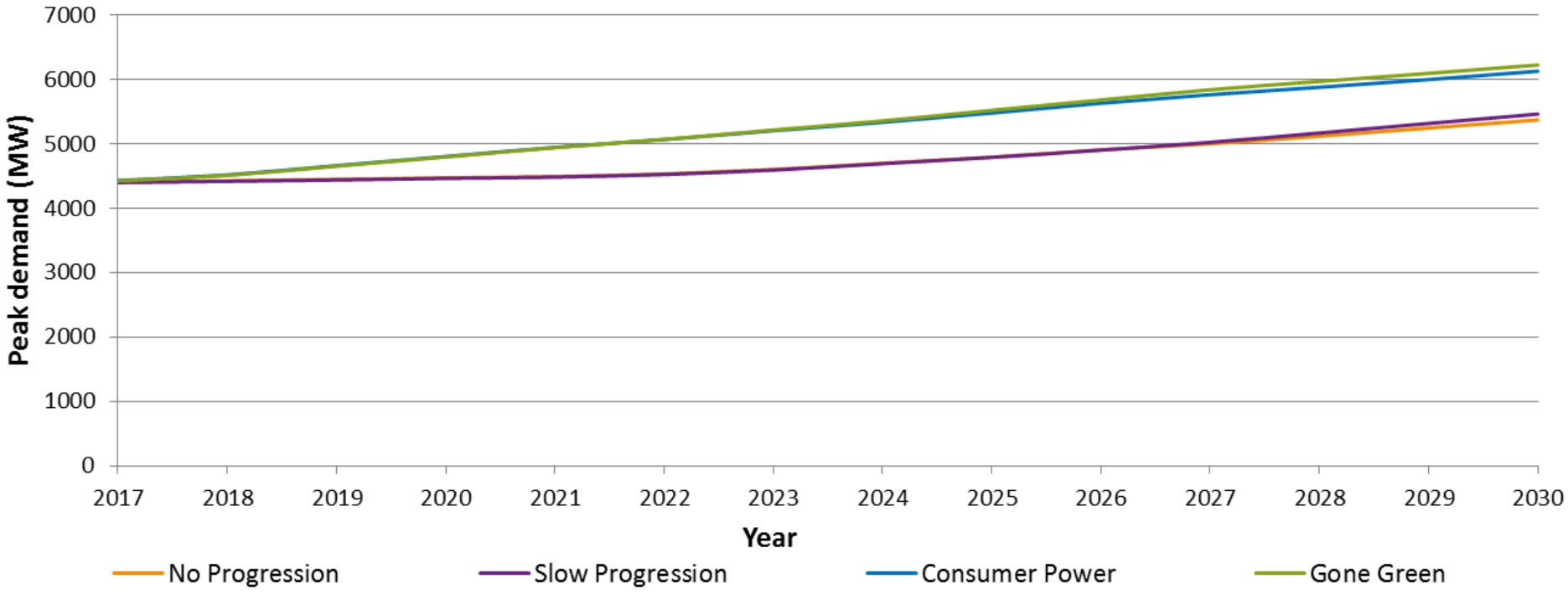
Scenarios – Demand Growth



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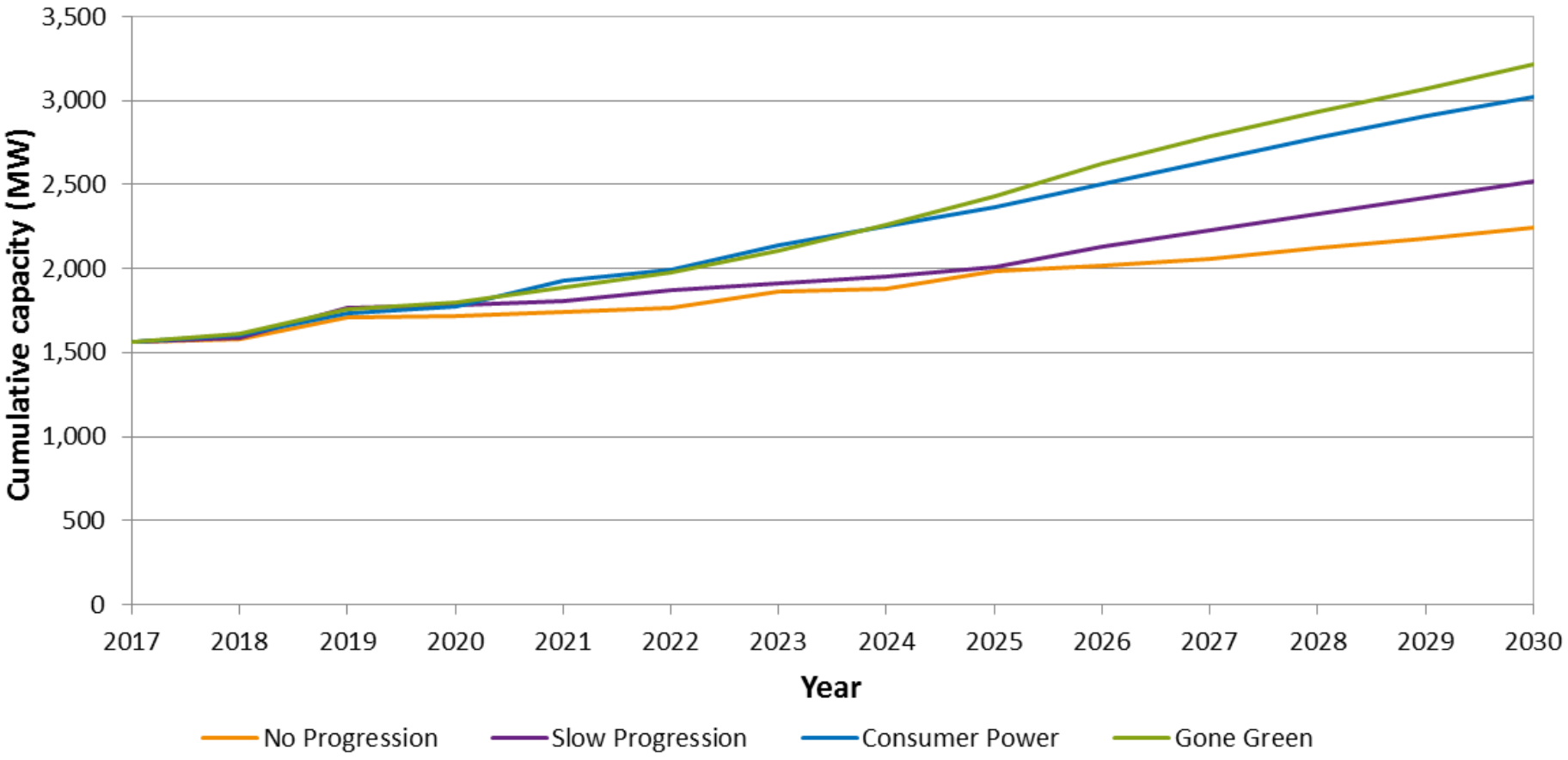
Scenarios – DG Growth



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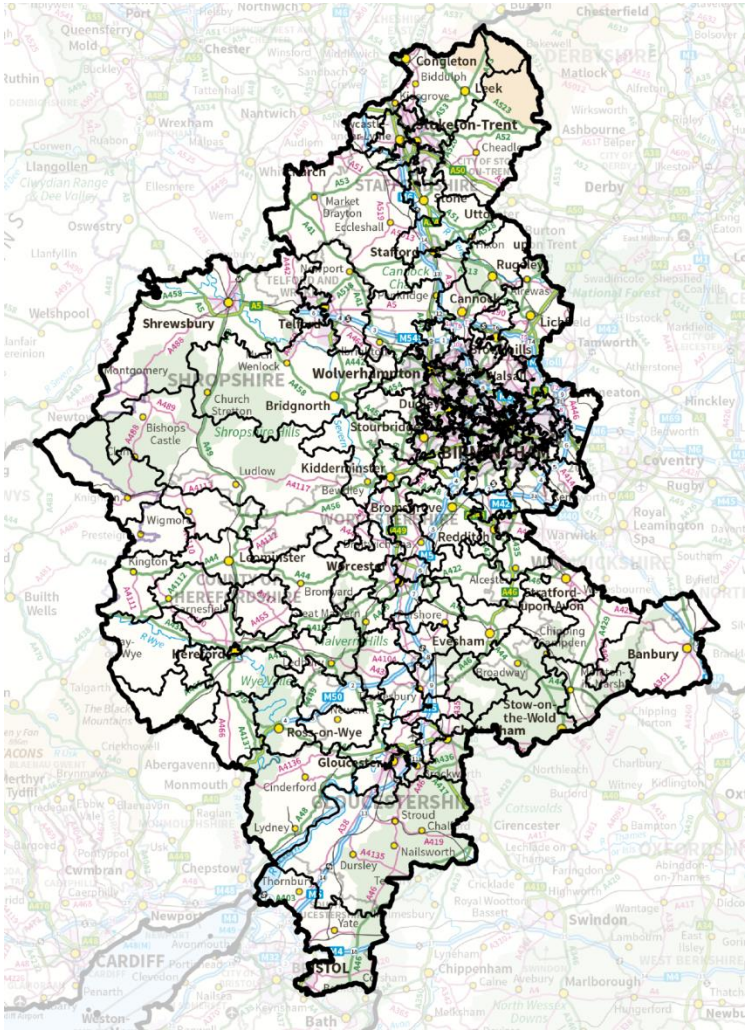
Network modelling

- West Midlands divided into Electricity Supply Areas (ESAs):
  - 132/66kV BSPs
  - 132/11kV BSPs
  - 132kV customers
- Scenarios developed at ESA granularity to provide link between geographical position of developments and WPD's network



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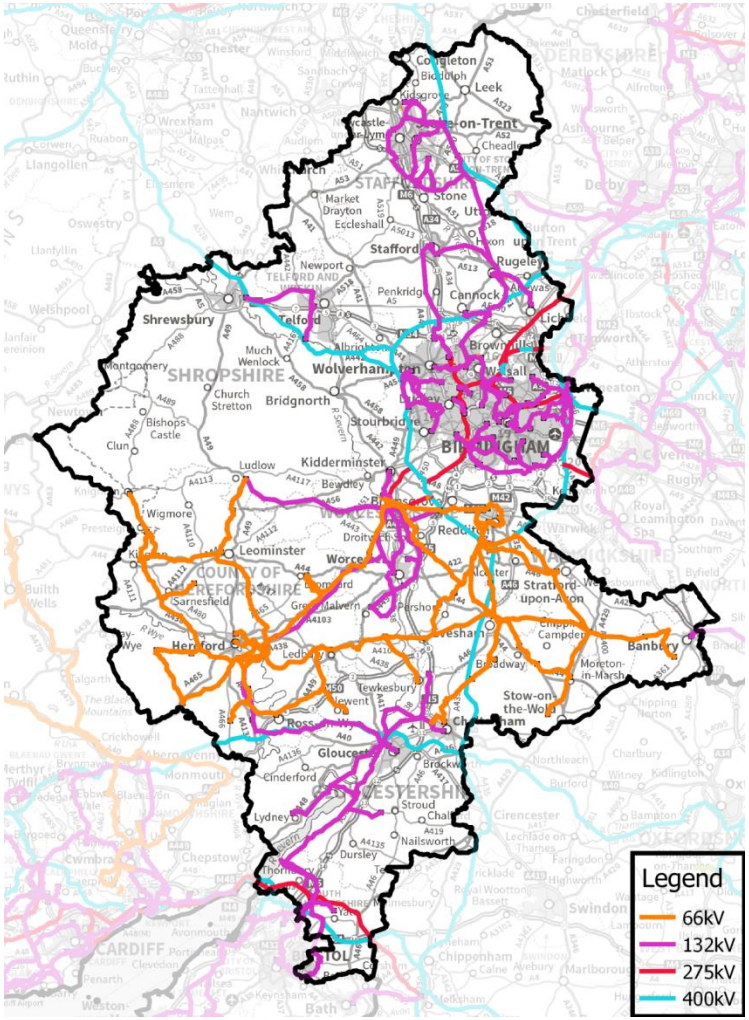
Network modelling

- Focus on the subtransmission network consisting of:
  - GSPs (400 or 275kV to 132kV)
  - 132kV network
  - BSPs (132/66kV, 132/33kV and 132/11kV)
  - 66kV network
  - 66/11kV Primaries
- Subtransmission reinforcement often protracted and expensive; requires long-term planning



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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 2017 and then the scenarios for 2020, 2025 and 2030

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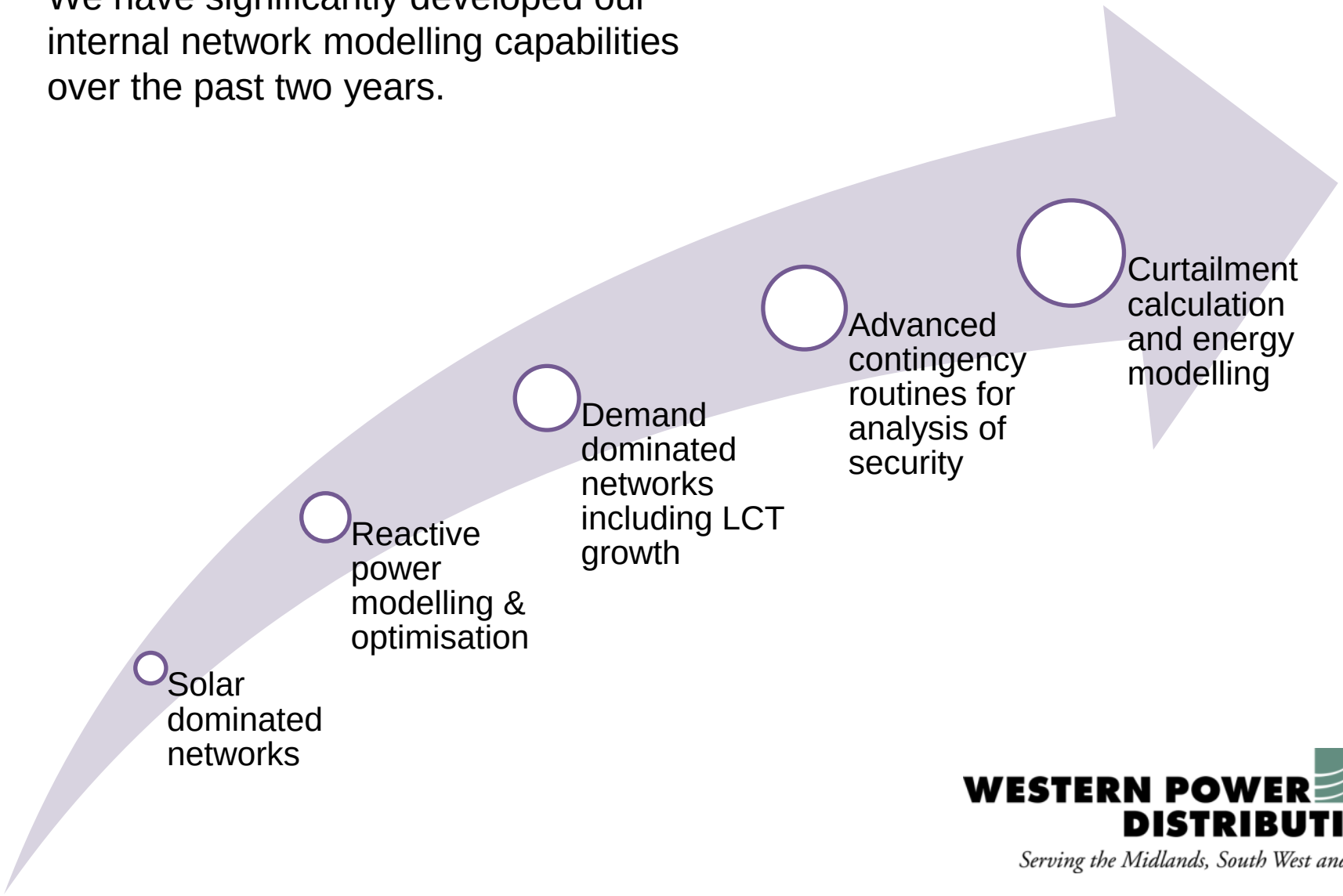
New Modelling Techniques

- West Midlands introduced differing autumn and summer peak demand days due to the differences between load profiles
- It also introduced the ‘midday peaking’ category of extra-urban substations, which are dominated by industrial demand
- We have significantly furthered our approach to automating the analysis for security of supply
- West Midlands, due to it’s large 66kV network, has been the largest study we’ve undertaken. It has more subtransmission assets than our South West and South Wales areas combined

New Modelling Techniques

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



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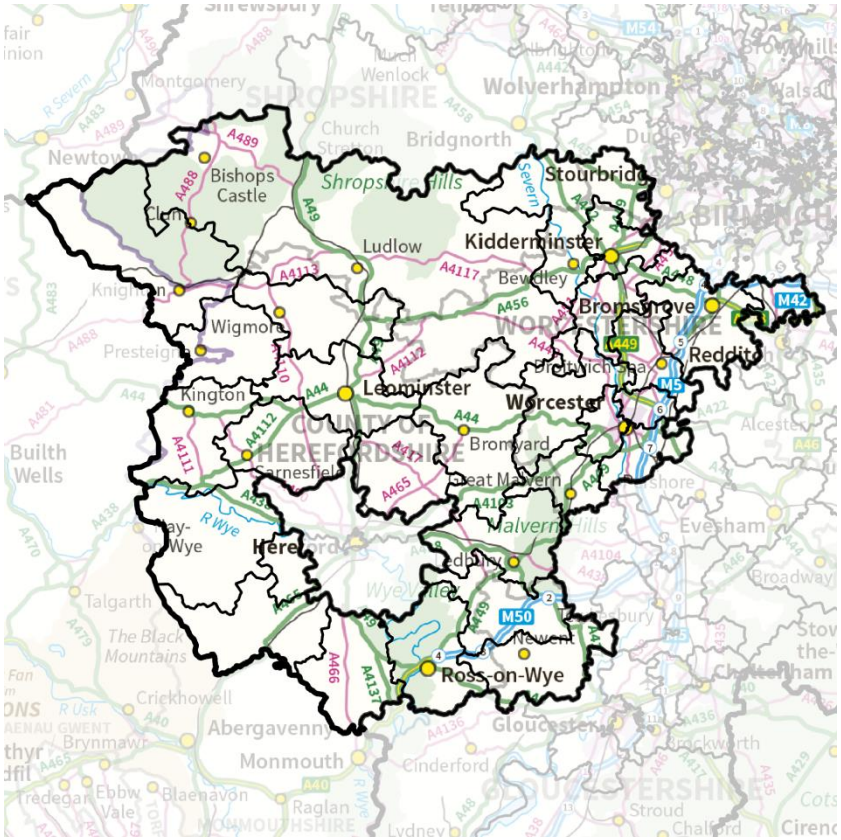
Results Overview

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 and 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

Results – Bishops Wood GSP



- Demand-driven reinforcement
- Hotspots:
  - Upton Warren area (demand in CP and GG)
- Proposed:
  - Replant Upton Warren 66/11kV and associated 66kV cable
  - Or add new 132/11/11kV GT

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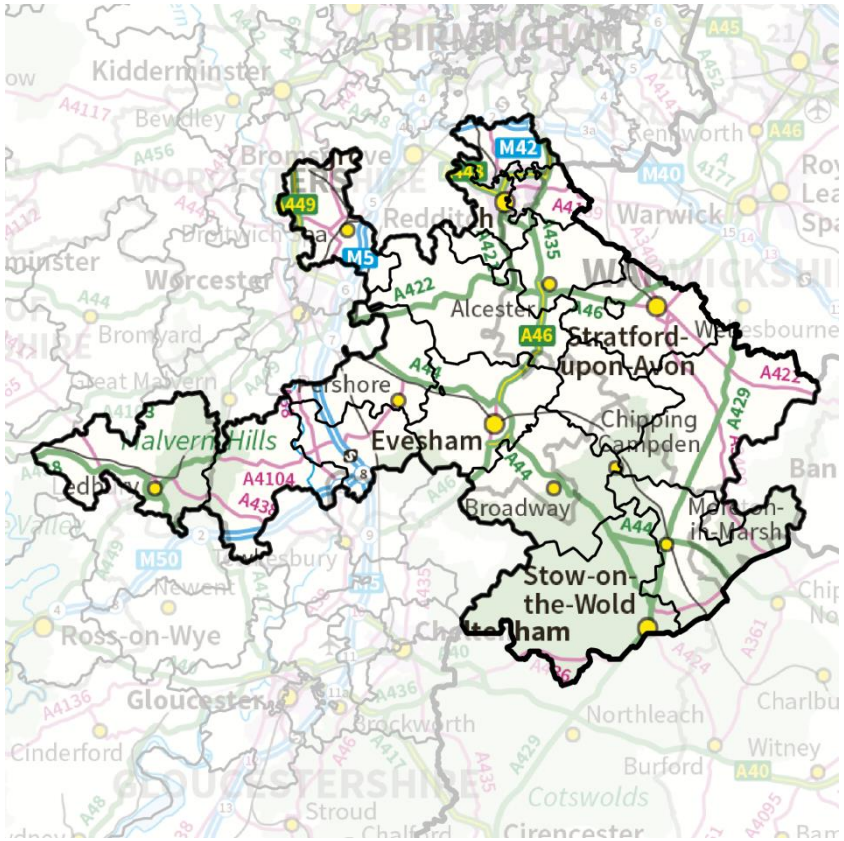
Results – Feckenham GSP



- Demand-driven reinforcement
- Hotspots:
  - Feckenham to Bevington CCT (demand)
  - Evesham Primary (demand)
- Proposed:
  - 66kV overhead line reconductoring, or
  - Automatic network reconfiguration.
  - Larger TXs at Evesham, or
  - Third TX at Evesham

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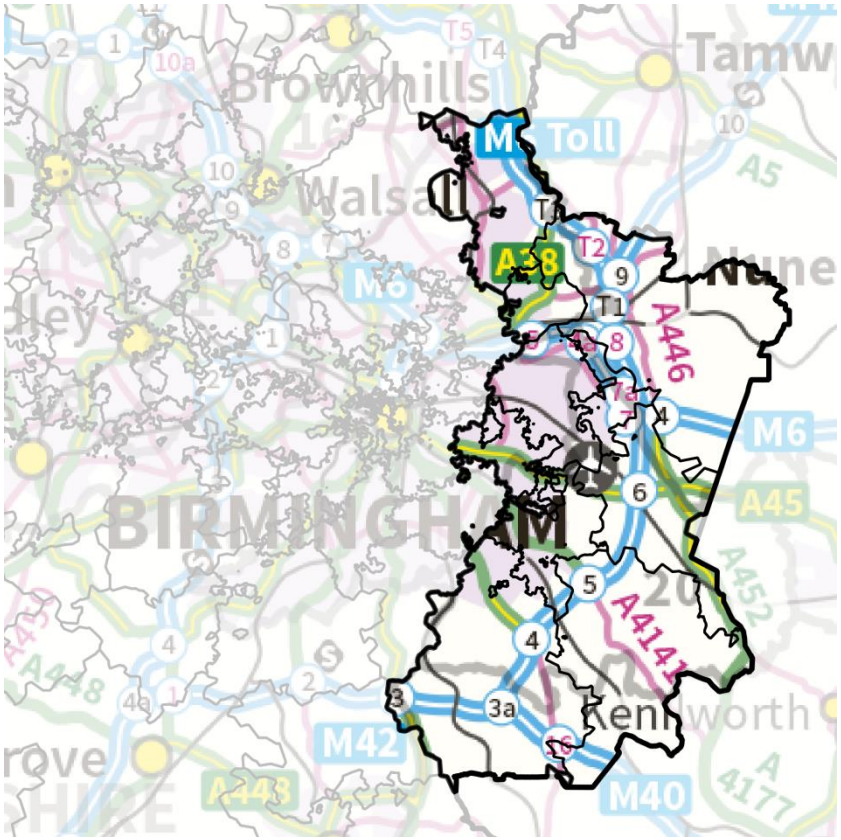
Results – Lea Marston GSP



- Demand-driven reinforcement
- Hotspots:
  - Copt Heath BSP
  - Elmdon BSP
  - Solihull BSP
  - GT1 at Shirley BSP
- Ongoing:
  - Lea Marston to Copt Heath 132kV rebuild
- Proposed:
  - Lea Marston to Elmdon 132kV reprofiling, or
  - Lea Marston to Elmdon 132kV overhead line reconductoring

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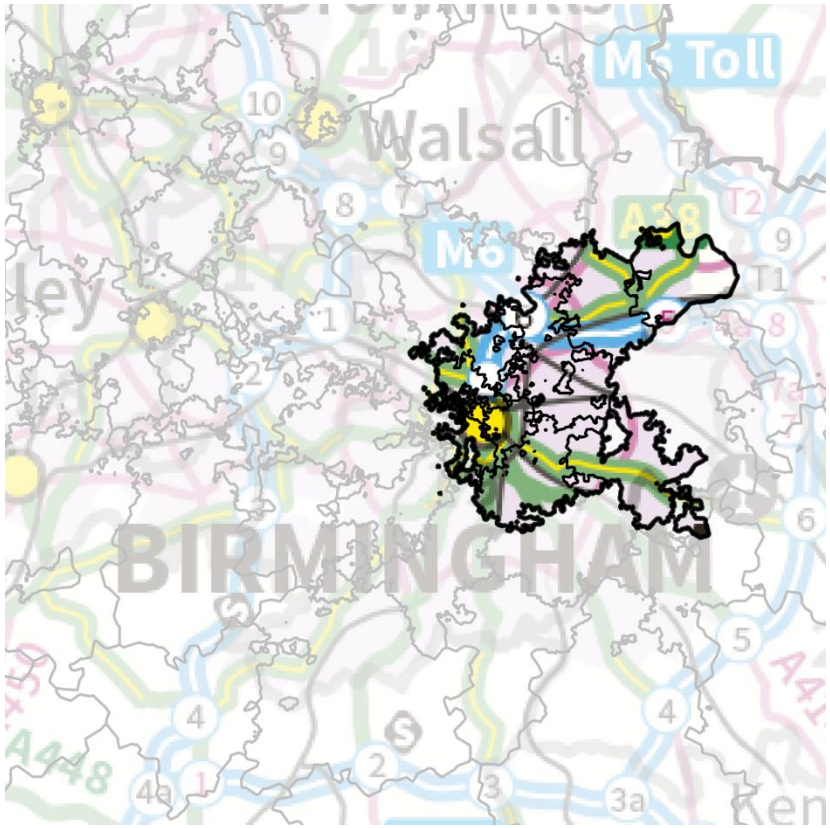
Results – Nechells GSP



- Demand-driven reinforcement
- Hotspots:
  - SGT capacity
- Proposed:
  - Run all four SGTs in parallel, or
  - Agree Short-term ratings (101% & 104%) with NG, or
  - Pre-fault demand transfers out, or
  - Reconfiguration of circuits at Kitts Green

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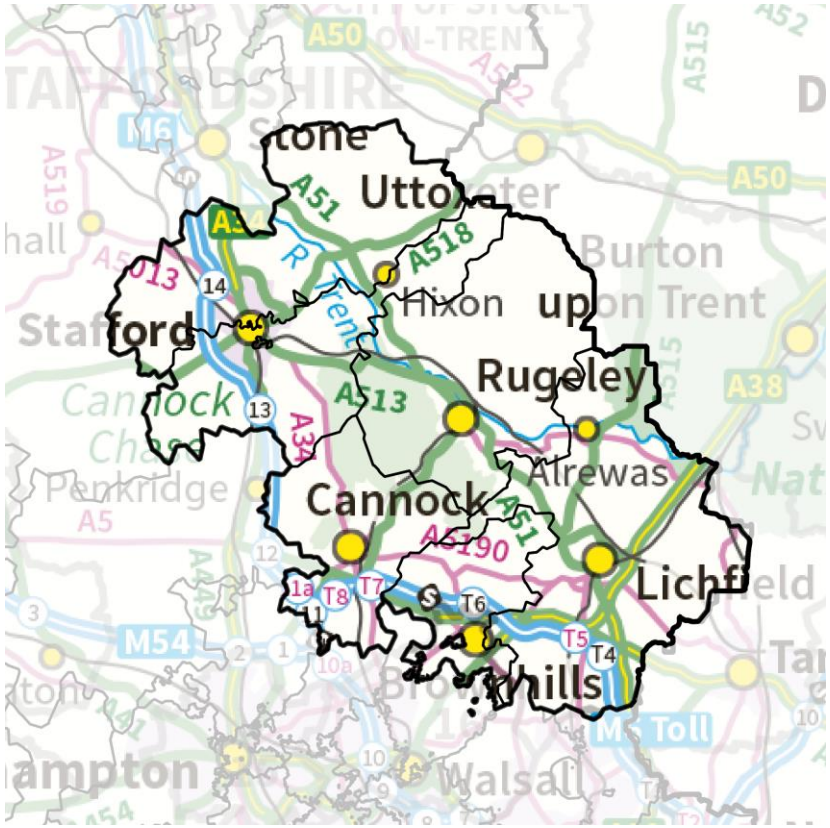
Results – Rugeley GSP



- Demand-driven reinforcement
- Hotspots:
  - SGT capacity
- Proposed:
  - 3rd SGT at Willenhall GSP
  - Demand transfers from Rugeley to Willenhall

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Results Overview

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 and 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

Results – Summary

- Network reinforcements are primarily driven by demand growth
- Most networks will need some intervention in 2025, Gone Green and Consumer Power scenarios
- Some networks are likely to 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.

Recommendations

- Develop and build 2020 reinforcement as necessitated by the actual growth of demand and DG:
  - Upton Warren BSP 11kV infeed;
  - Feckenham GSP 66kV busbar;
  - Evesham Primary substation;
  - Ironbridge-Shrewsbury 132kV network;
  - Copt Heath/Elmdon 132kV network;
  - Nechells GSP SGT capacity;
  - Hereford South Primary substation;
  - Rugeley GSP SGT capacity; and
  - Willenhall GSP SGT capacity.

Recommendations

- Develop and build 2025 reinforcement as necessitated by the actual growth of demand and DG:
  - Transformer capacity at Port Ham/Walham GSP, Bishops Wood GSP and Hereford BSP; potentially a new GSP at Hereford;
  - Additional GTs at Malvern BSP and Warndon BSP;
  - Busbar fault mitigation at Bushbury GSP;
  - Meaford C BSP;
  - The wider development of the Cellarhead 132kV network;
  - SGT capacity at Feckenham GSP; potentially a new GSP to the south of Feckenham;
  - Primary transformer capacity at Pershore and Evesham;
  - Further 132kV infeed to the northern part of the Ironbridge-Shrewsbury network;
  - 132kV circuit reinforcement to the east of Kitwell GSP;
  - SGT capacity at Lea Marston/Hams Hall GSP;
  - 132kV circuit reinforcement between Lea Marston and Elmdon;
  - A third GT at Hams Hall South BSP;
  - A third GT and 132kV circuit for Solihull BSP;
  - GT capacity at Black Lake BSP;
  - Transformer capacity at Hinksford BSP;
  - GT capacity at Lydney BSP;
  - SGT capacity at Rugeley and Willenhall GSPs; and
  - GT capacity at Rugeley Town BSP.

Further work

- As we progress towards 2030 and have more concrete pathways to the low carbon transition, it is important to revisit the studies and update our assumptions
- Undertake whole system studies with other transmission and distribution system operators
- Understand the technical viability of supplying the energy required by our customers from intermittent renewables and clarify the impacts upon network capacity, curtailment and/or energy storage requirements
- Repeat studies in two years

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

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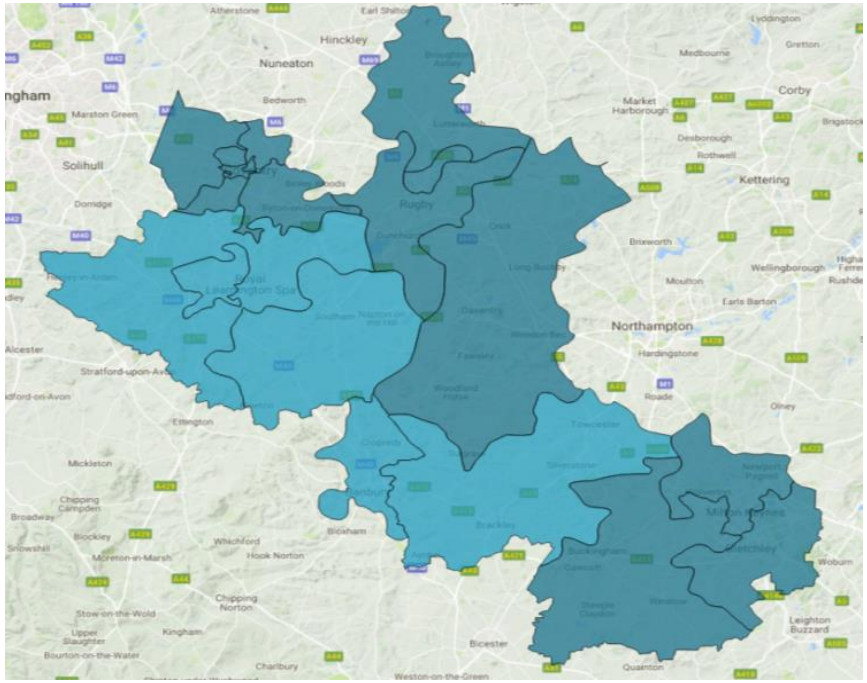
Looking to the Future



- Project ENTIRE (NIA)
- In WPD's East Midlands licence area
- Along the M1-M40 corridor
- 14 Constraint Management Zones (CMZ)
- Marketed as Flexible Power
- 3 new DSR services
  - Secure
  - Dynamic
  - Restore
- Pre and Post Fault constraint resources

Flexible Power
By Western Power Distribution

www.flexiblepower.co.uk

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Looking to the Future

During 2018 and 2019 WPD will begin to facilitate new local flexibility markets and empower our customers to provide benefits across the whole electricity system.

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How should works be financed?

- We will continue to apply the charging methodology approved by Ofgem i.e. where a connection triggers reinforcement, a contribution towards the cost of that reinforcement will form part of the connection charge, however
- It is becoming increasingly difficult to clearly determine the cause of reaching the limit for the network as:
  - There is a slow but steady reduction in demand levels (a combination of efficiency at the customer level and behind the meter generation)
  - Connections at HV and LV do not contribute to 132kV reinforcement works – whilst we can delay their connection the economic timing of 132kV works depends on the confidence that EHV connections will proceed
  - We're obliged to offer connections up to the limit of the network capability, hence we can suddenly reach the point where there is no capacity for lower voltage connections
- We are interested in developing methodologies for how non-wires alternatives to reinforcement might be paid for

Other issues to address

- Abnormal operating conditions – whilst our connection agreements are clear that we have the right to constrain generation under abnormal operating conditions, it is not possible to accurately define the risk that this imposes on an individual customer
- How should security be developed in the future? Is there an economic limit or should we be aiming for ‘destination zero’
- P2 review – P2/7 has just finished the consultation period and, if approved, will further facilitate non-build solutions
- In September 2017, WPD published the first version of the Distribution System Operability Framework
- ENA’s Open Networks project will further develop System Operability Frameworks published by WPD and NGET into a ‘whole system’ SOF

D SOF

Assets	Network Operations	Customers
Analysing data, enhancing modelling techniques and testing alternative connection strategies.	Demonstrating the direct benefits from smart grids for network performance and service delivery.	Developing new technologies and solutions to meet customer's needs, such as enabling the connection of Low Carbon Technologies (LCT).
Articles: 1. Network Modelling and Analysis 2. Network Monitoring and Visibility 3. Data and Forecasting	**Articles:** 1. Fault Level Management 2. Arc Suppression Coils 3. Low Frequency Demand Disconnection	**Articles:** 1. Flexibility Services 2. Changing Demand Profiles 3. Power Quality

The DSOF aims to highlight some of the technical and commercial challenges facing Distribution Network Operators as they become Distribution System Operators.

The challenges are presented as subject articles in the three core areas which are identified in WPD's business plan.

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Summary

- We have completed regional strategy investment option reports out to 2030 across all of our four licence areas
- Significant envelope of potential change in generation and demand assessed and issues arising and potential solutions identified
- Whole system network studies across transmission and distribution system and network operators should be furthered
- Operability issues should be considered under a ‘W-SOF’
- We will continue to undertake these studies on a two year rolling window for the future as business as usual
- The next round will begin to consider annual energy requirements as well as local power requirements
- These reports will feed into regional network and service requirements as part of ENA’s Open Networks project

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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?

What other information can we share?

Any missing stakeholders?

Can we do more to stimulate consortium approaches?

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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:

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