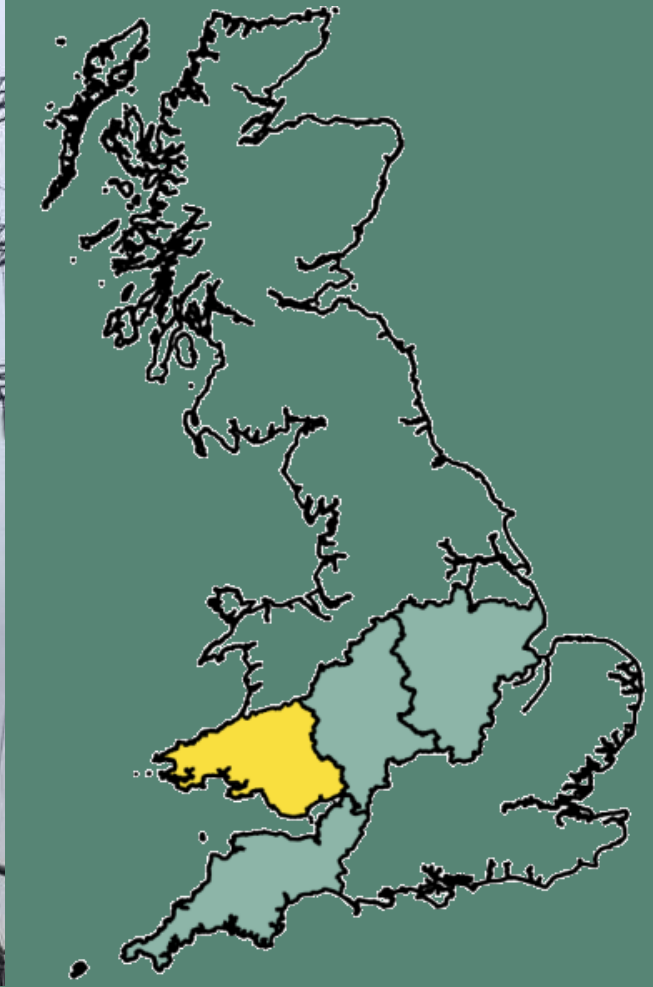
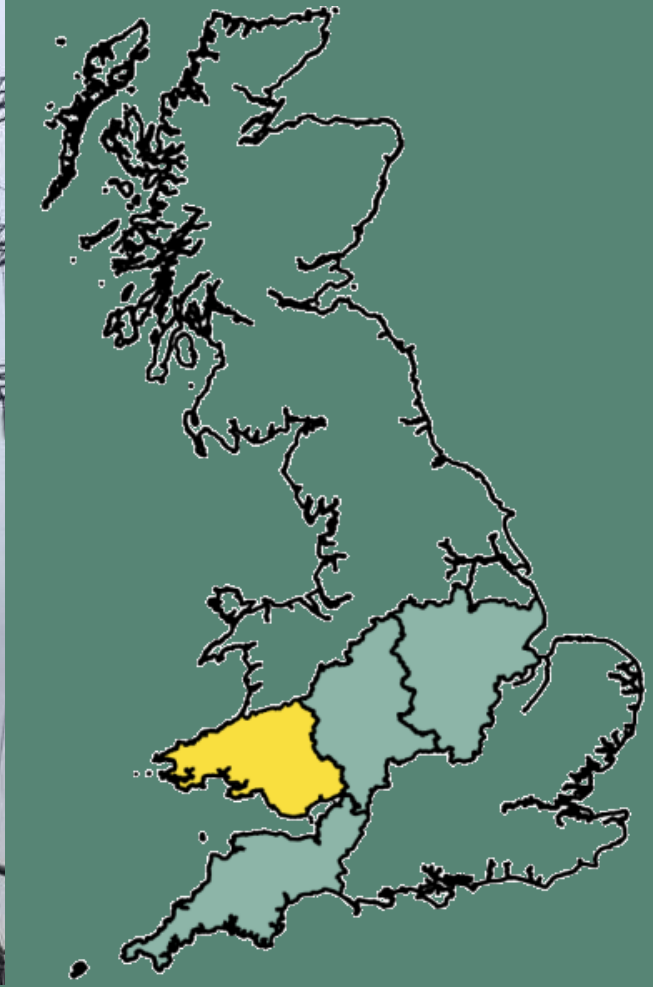


Welcome

The webinar will begin shortly after 11am

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales



Shaping Subtransmission to 2030

South Wales
2016 Studies

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 thermal and voltage constraints under these scenarios that will limit the ability of new demand and generation connections to take place
- 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 of 2.1GW and minimum demand of 0.8GW
- Unprecedented growth of DG in South Wales:

	Connected [MVA]	Accepted [MVA]	Offered [MVA]	Total [MVA]
Battery	-	61	70	**131**
Photovoltaic	530	491	47	**1,067**
Wind	343	386	47	**776**
All Other Generation	923	687	126	**1,735**
Grand Total	**1,796**	**1,624**	**289**	**3,709**

Background

- Significant usage of inherent capacity by connected and contracted generation
- Due to both cost and timescales for reinforcement, alternative connection arrangements or connections elsewhere increasingly preferred by generation
- Both distribution reinforcement requirements and Statement of Works (SoW) process have caused uncertainty and difficulties for generation customers to commit investment in their projects
- Whilst volumes of applications for large scale connections have fallen the cost of the technology continues to go down and, excluding significant grid reinforcement costs, price parity for large (>10MW) solar could be reached by 2020

Committee on Climate Change report June 2016

- Key message – while sufficient progress in low carbon generation has been made to meet the committee's indicators for 2020,
  - '*longer term development of low carbon capacity is at risk and not consistent with achieving carbon intensity below 100gCO_2/kWh by 2030*'
  - '*To reduce emissions at lowest cost, policy should provide a route to market for onshore wind and solar, ensuring that cost effective projects are able to compete fairly with other technologies and obtain long-term contracts at a price that implies no additional subsidy'*

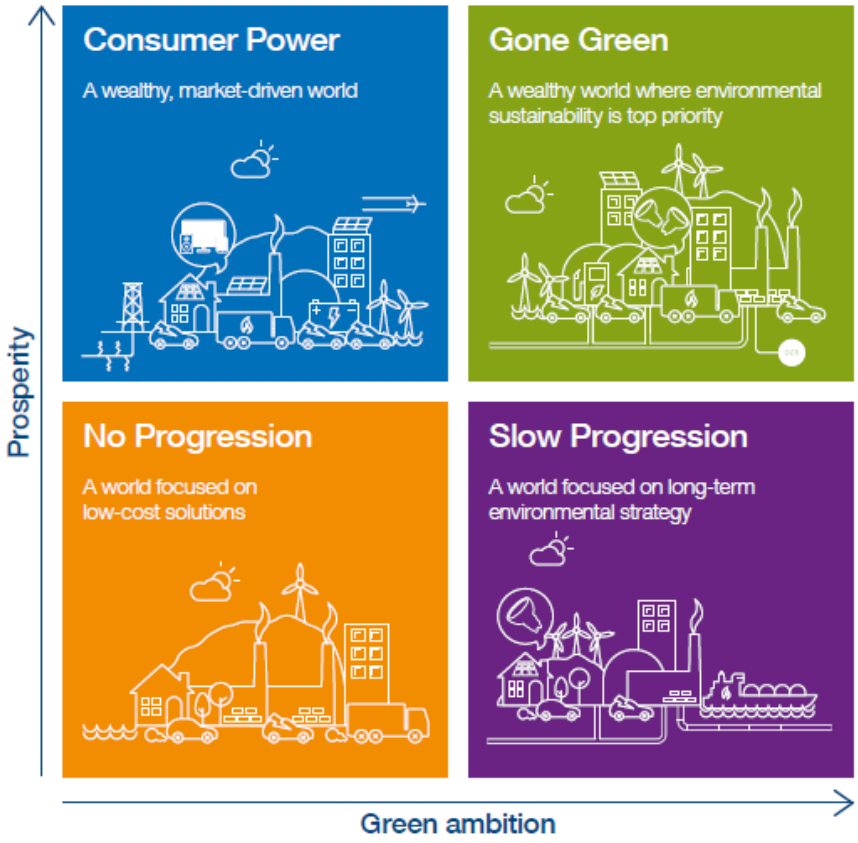
WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Scenarios

- Growth of:
  - Distributed generation (DG)
  - Heat pumps (HPs)
  - Electric vehicles (EVs)
  - Battery storage

  in South Wales forecast by Regen SW from 2016 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

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

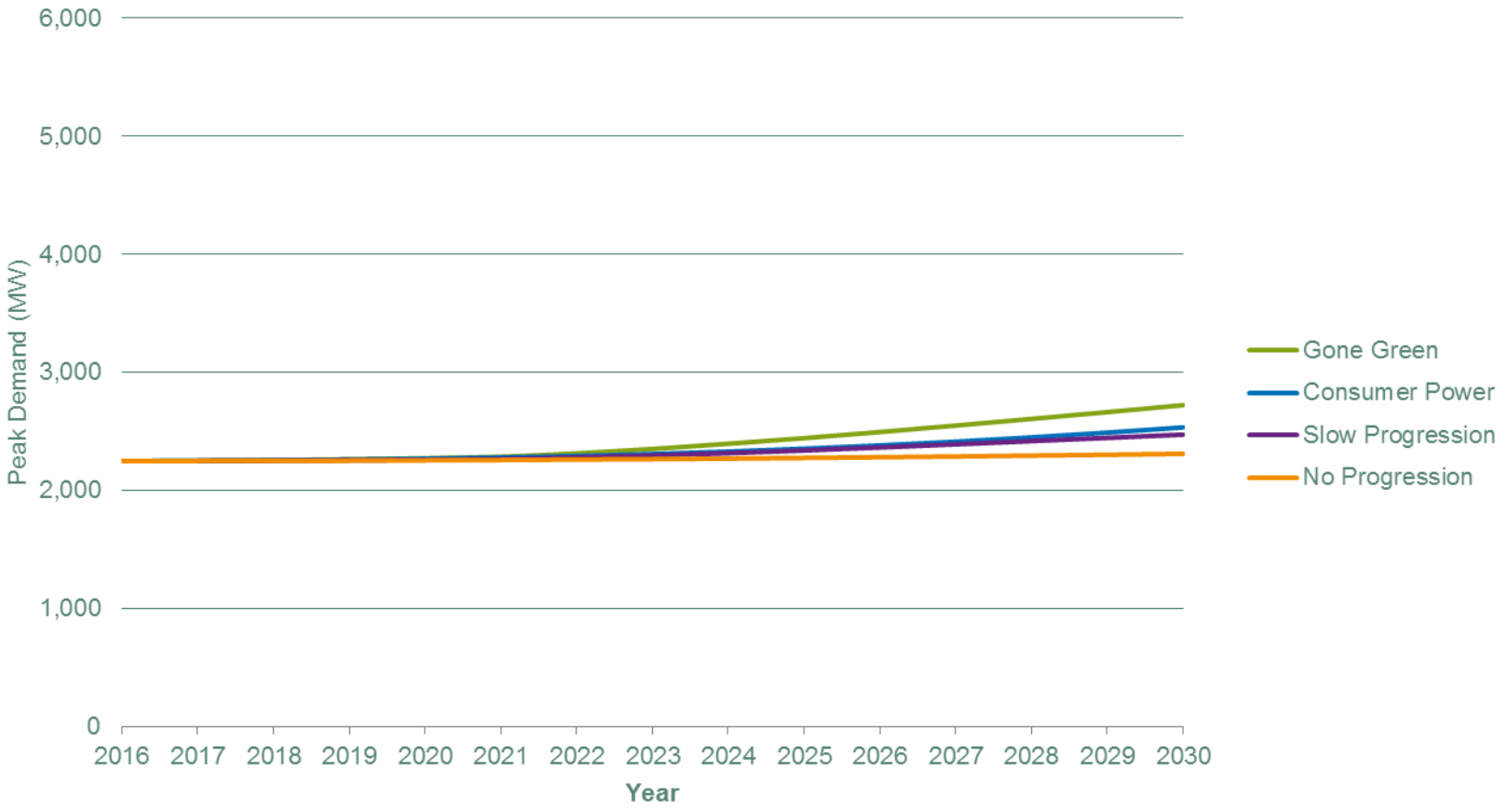
Analysis by:
1) Technology type
2) BSP Areas
3) GIS mapping
4) Historic growth trend

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

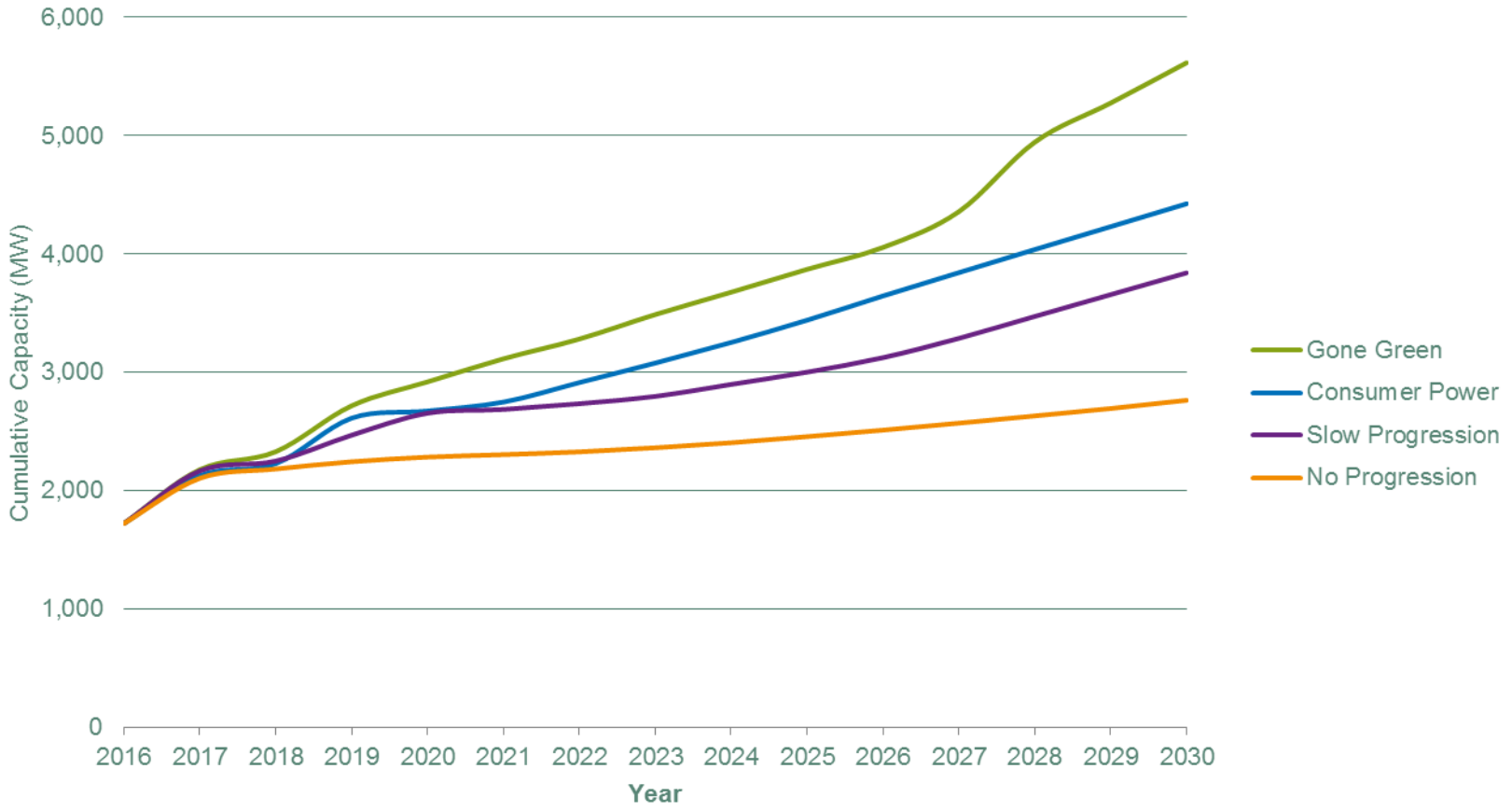
Scenarios – Demand Growth



WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Scenarios – DG Growth



WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Network modelling

- South Wales divided into Electricity Supply Areas (ESAs):
  - 132/33kV BSPs
  - 132/11kV BSPs
  - 66/11kV primaries
  - 132 and 66kV customers
  - Future wind development zones
- 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 132, 66 or 33kV)
  - 132kV network
  - BSPs (132/66kV, 132/33kV and 132/11kV in South Wales)
  - 66kV network
  - 66/11kV primary substations
- Subtransmission reinforcement often protracted and expensive; requires long-term planning

Network modelling

- Previous analysis has focused on the expected peak/minimum demand conditions. This study modelled each half-hour for:
  - Summer day (DG dominated)
  - Winter day (demand dominated)
  - Typical spring/autumn day
- Intact network, first-circuit outages, second-circuit outages and busbar outages analysed
- Profiles of generation/demand were determined using a combination of historic 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 2016 and then the scenarios for 2020 and 2025

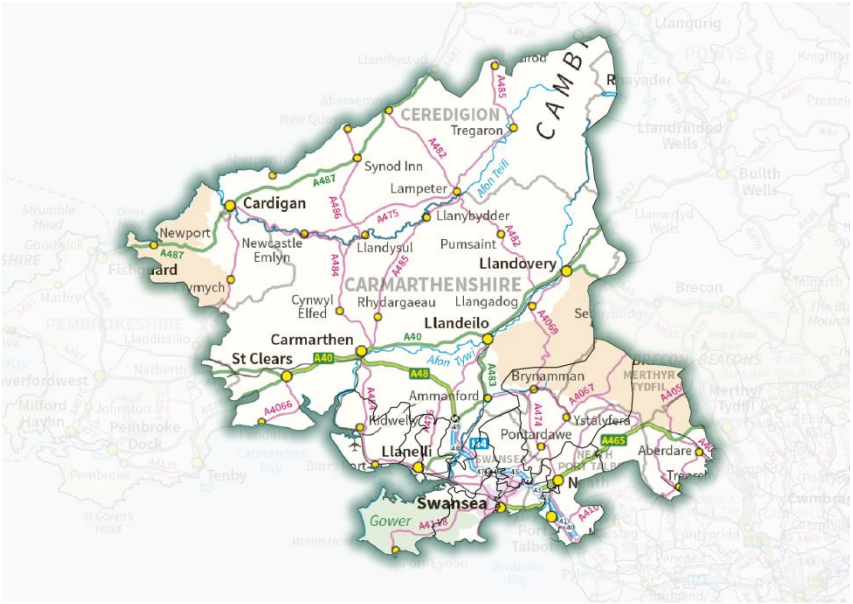
Results – Pembroke GSP

- Large area, reliant on 33kV interconnection between BSPs
- DG-driven
- Reinforcement:
  - 132kV overhead line reprofiling
  - 132kV cable overlays
  - Replacement and additional 132/33kV grid transformers
  - 33kV reconfiguration

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Results – Swansea North GSP

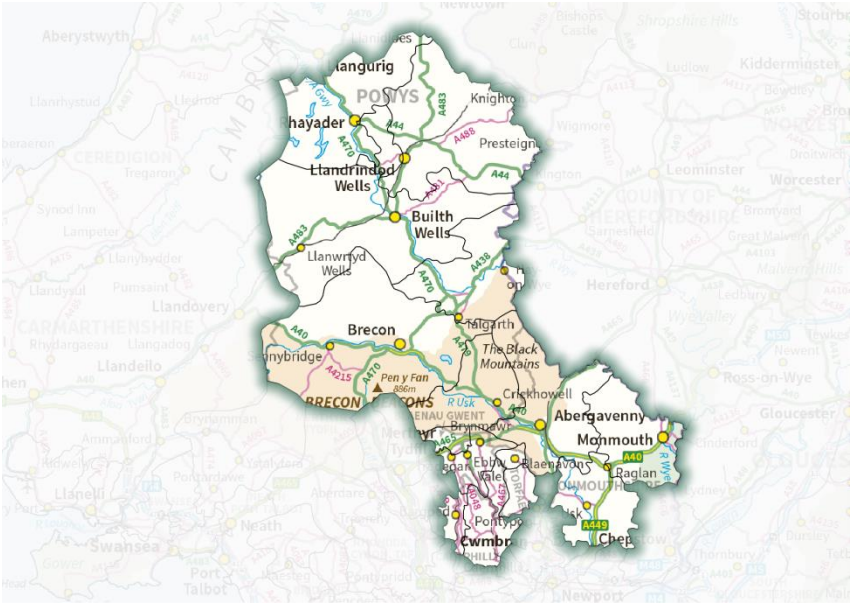


- Large area, reliant on 33kV interconnection in rural areas
- DG-driven reinforcement
- Hotspots:
  - Carmarthenshire and West Wales
  - North of Swansea and Heads of the Valleys
- Reinforcement:
  - 132kV overhead line reprofiling
  - 132kV cable overlay
  - Replacement and additional 132/33kV grid transformers
  - 33kV reconfiguration
  - Potential new GSP in 2025

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Results – Rassau GSP

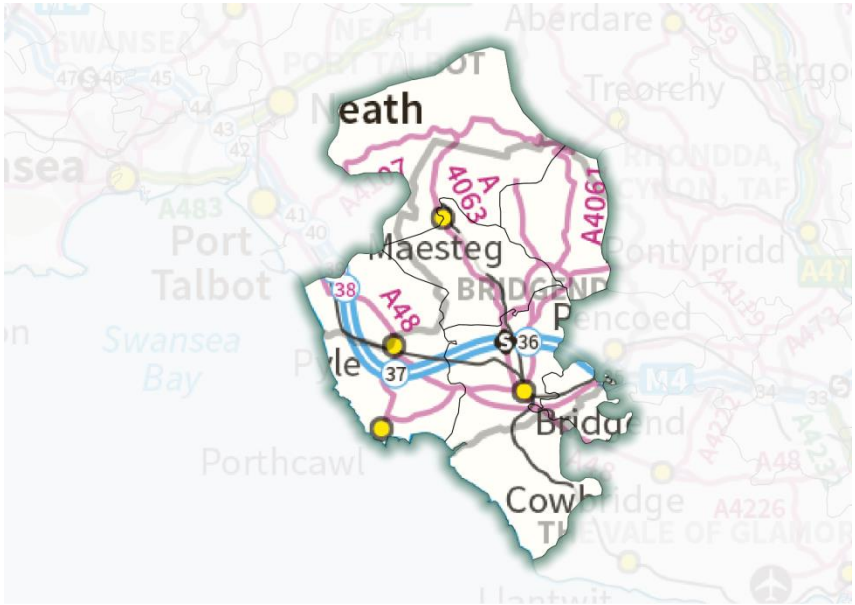


- Legacy 66kV network supplying large area from outskirts of Newport to rural mid-Wales
- Demand- and DG-driven
- Reinforcement:
  - Statcoms to improve utilisation of existing long, reactive 66kV circuits
  - Replacement and additional 66/11kV primary transformers
  - Advanced voltage control schemes

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Results – Margam and Pyle GSPs



- Llynfi Valley, isolated pocket of legacy 66kV network
- Good wind resource
- DG-driven
- New connections may lead to several separate 66kV circuits
- 132kV consenting timescales impractical

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Results – Summary

- Heavily scenario dependent
- Requirements also identified in Aberthaw, Cardiff East, Upper Boat and Uskmouth GSPs
- Most reinforcement DG-driven, but some demand-driven
- DG-driven reinforcement may be necessary to maintain P2/6 compliant supplies to demand customers

Network management and automation

ANM can avoid expensive reinforcement, however there are:

- Commercial limits on acceptable curtailment
  - High percentage of time curtailment is unlikely to be acceptable to generators
- Technical limits on abilities of ANM scheme and network
  - Complexity – implementation across large interconnected networks leads to high levels of forecast constraint due to overlapping causes of constraint
  - Equipment rating under sustained high loading need careful consideration
  - Operating times vs equipment short term ratings and protection operation – pre curtailment of generation under certain operating or load conditions can solve this but high level of constraint often result

Interface with NGET

- As highlighted by the Statement of Works/Modification Application process, we have also reached the limit of the transmission system in South Wales
- WPD recently received Modification Offers from NGET relating to Thermal Plant connecting in South Wales:
  - Significant reinforcement works required on 275kV and 400kV circuits between South Wales and England taking many years to complete
  - WPD currently reviewing Modification Offers and communicating with customers whose connections are party to this Modification Application process
- WPD is currently working with National Grid to develop a Regional Development Programme that would carry out transmission/distribution interface studies. This is currently limited to a trial covering WPD's South West licence area.

Recommendations

- Develop and build 2020 reinforcement as necessitated by the actual growth of demand and DG:
  - Mid-Wales (Abergavenny) 66kV ring;
  - Grange-Llynfi and Pyle-Llynfi 66kV networks;
  - Pembrokeshire 132kV and 33kV networks;
  - Southern (Abergavenny/Panteg) 66kV ring;
  - Carmarthenshire and West Wales 132kV and 33kV networks;
  - North of Swansea and Heads of the Valleys area 132kV and 33kV networks; and
  - Upper Boat/Mountain Ash 33kV network.
- Revisit studies with National Grid
- Further work on the technical limits of network management and automation
- Improve analysis of 132kV parallels
- Repeat studies in two years

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 have reached the point where certain reinforcements are being classed, or largely classed, as general reinforcement due to not being able to attribute to specific connections

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 a generator.
- Better defining commercial rights and hence conditions for compensation is likely to be the best long term way to address this
- P2 review – the current conclusion of the P2 review process is that there is no economic case for a security of supply for groups of generation below 1320MW.
- Distribution System Operability Framework – some of the issues highlighted while undertaking this study will be incorporated into a D SOF currently being worked on
- It is likely that the current NGET produced System Operability Framework will evolve into a ‘whole system’ SOF

D SOF

- Whilst in the early stages of development, some of the areas being assessed are:

Networks	Performance	Customers
Network modelling *What further modelling capability needs to be added?*	Arc Suppression Coils *At what point will ASC earthing in Cornwall need to be replaced?*	Power Quality *How will new technology types and demand growth affect our power quality?*
Network monitoring *What additional monitoring of the network is required?*	Fault Levels *What are the effects of rising and falling fault levels on our network?*	Dispatch Coordination *Between DNO/DSO and SO, suppliers and customers for demand/generation dispatch or curtailment?*
Active Network Management *What are the limitations of current and proposed ANM systems used by WPD and NGET?*	Low Frequency Demand Disconnection *To what extent are generation dominated networks degrading LFDD?*	Customer Demand Profiles *How will changing customer demand profiles affect how we design and operate our network?*

Summary

- First time we have undertaken such a long term comprehensive analysis of the network in South Wales
- Significant envelope of potential change in generation and demand assessed and issues arising and potential solutions identified
- Further work with NGET recommended
- Issues needing consideration under a ‘D SOF’ also highlighted
- Work underway to repeat for the East Midlands network incorporating lessons learnt during the South Wales and South West studies
- This is part of a long term cycle of assessment of the network

Any questions?

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

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Further information

- Reports/presentations are available from:

http://www.westernpower.co.uk/About-us/Our-Business/Our-network/Strategic-network-investment.aspx

- Questions/enquiries via:

wpdnetworkstrategy@westernpower.co.uk

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales