



# Welcome

The webinar will begin shortly after 2pm



# Shaping Subtransmission

South Wales  
2019 studies

# Agenda

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

# Objectives

- Forecast growth of demand, generation and storage over four industry-aligned economic and environmental scenarios;
- Develop regional distributions of technologies connecting to our network;
- 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.

# Background

- Network designed for demand
- Current maximum demand around 1.9GW and minimum demand below 0.9GW
- Strong mix of generation

	Connected [MVA]	Accepted [MVA]	Offered [MVA]	Enquired [MVA]	Total [MVA]
Energy Storage	-	21	-	-	<b>21</b>
Photovoltaic	632	341	181	1	<b>1,155</b>
Wind	503	243	15	-	<b>761</b>
All Other Generation	1,059	285	163	148	<b>1,655</b>
<b>Grand Total</b>	<b>2,194</b>	<b>890</b>	<b>359</b>	<b>149</b>	<b>3,592</b>

# Background

- Significant amount of generation connected across the network
- Wide mixture of generation technologies means a greater diversity of operation
- Peak forward power limitations coincide at winter peak due to heating and lighting demands
- Active Network Management operating to mitigate transmission equipment constraints
- 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.

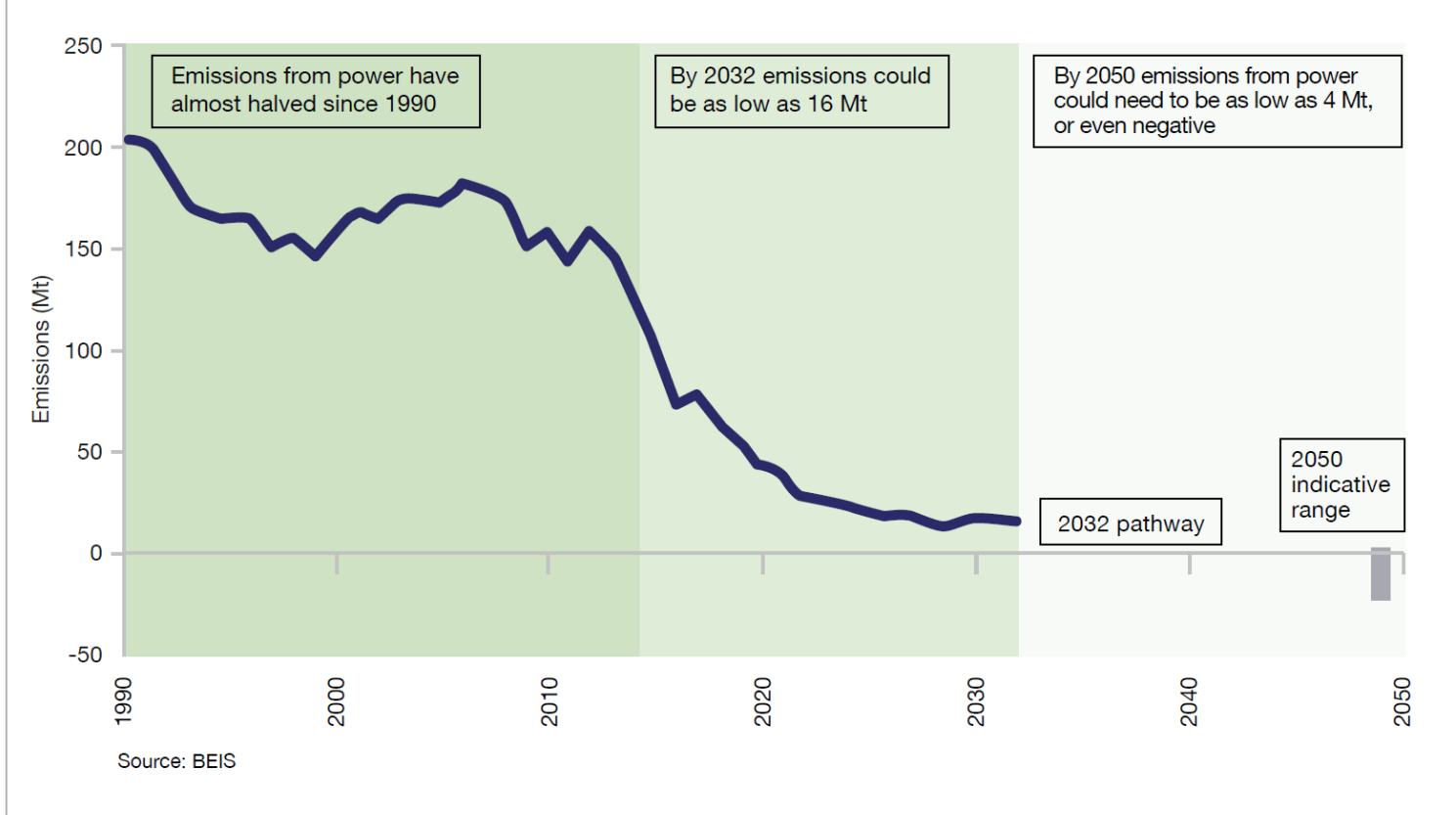
# Clean Growth Strategy (BEIS)

## **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)

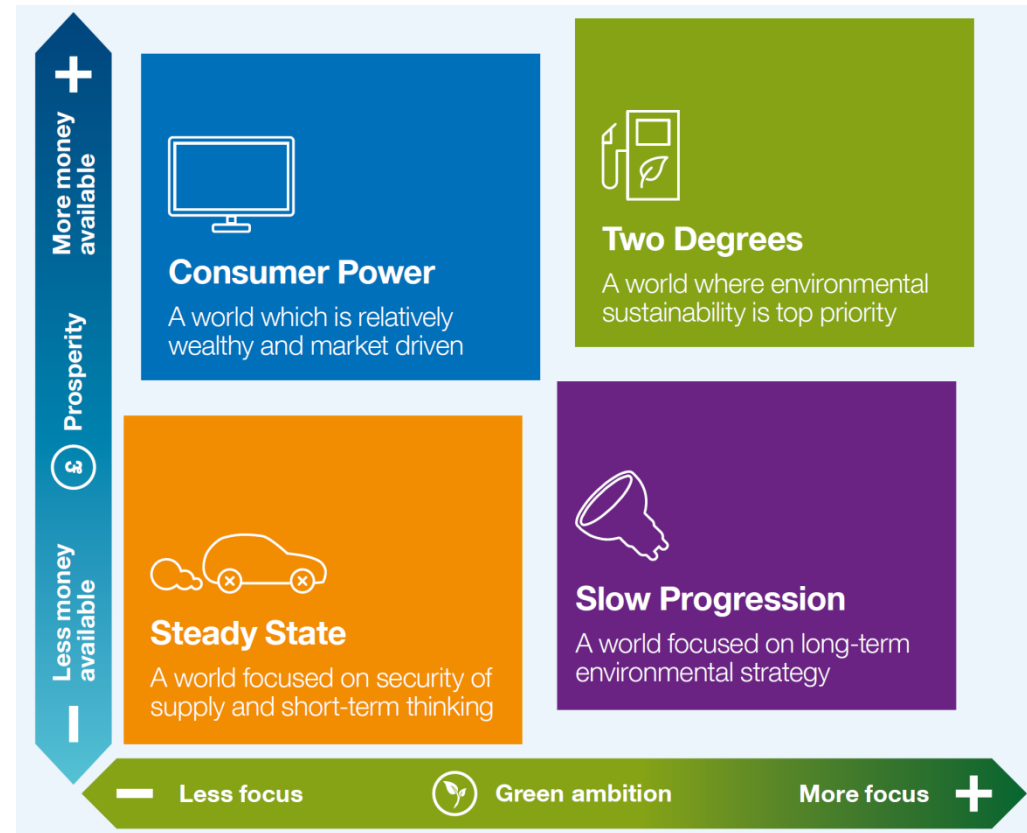
Figure 25: Actual and projected power sector emissions, taking into account the clean growth pathway, 1990-2050





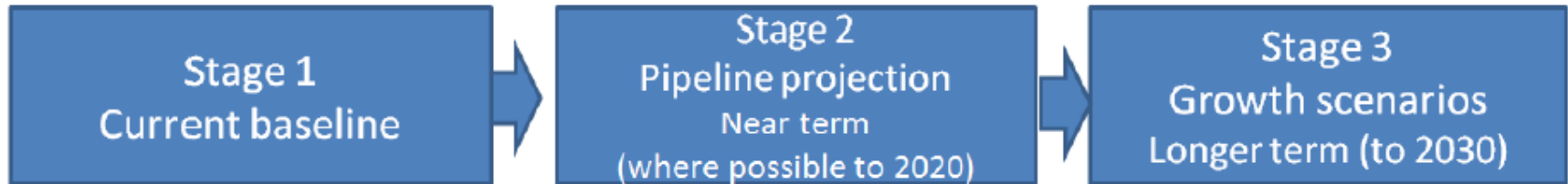
# Scenarios

- Growth of:
  - Domestic, industrial and commercial demand
  - Distributed generation (DG)
  - Heat pumps (HPs)
  - Electric vehicles (EVs)
  - Battery storagein South Wales forecast by Regen from 2018 to 2032
- Four scenarios corresponding to NG FES (2017):
  - Two Degrees
  - Consumer Power
  - Slow Progression
  - Steady State
- Moving to FES 2018 for East Midlands



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

# 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

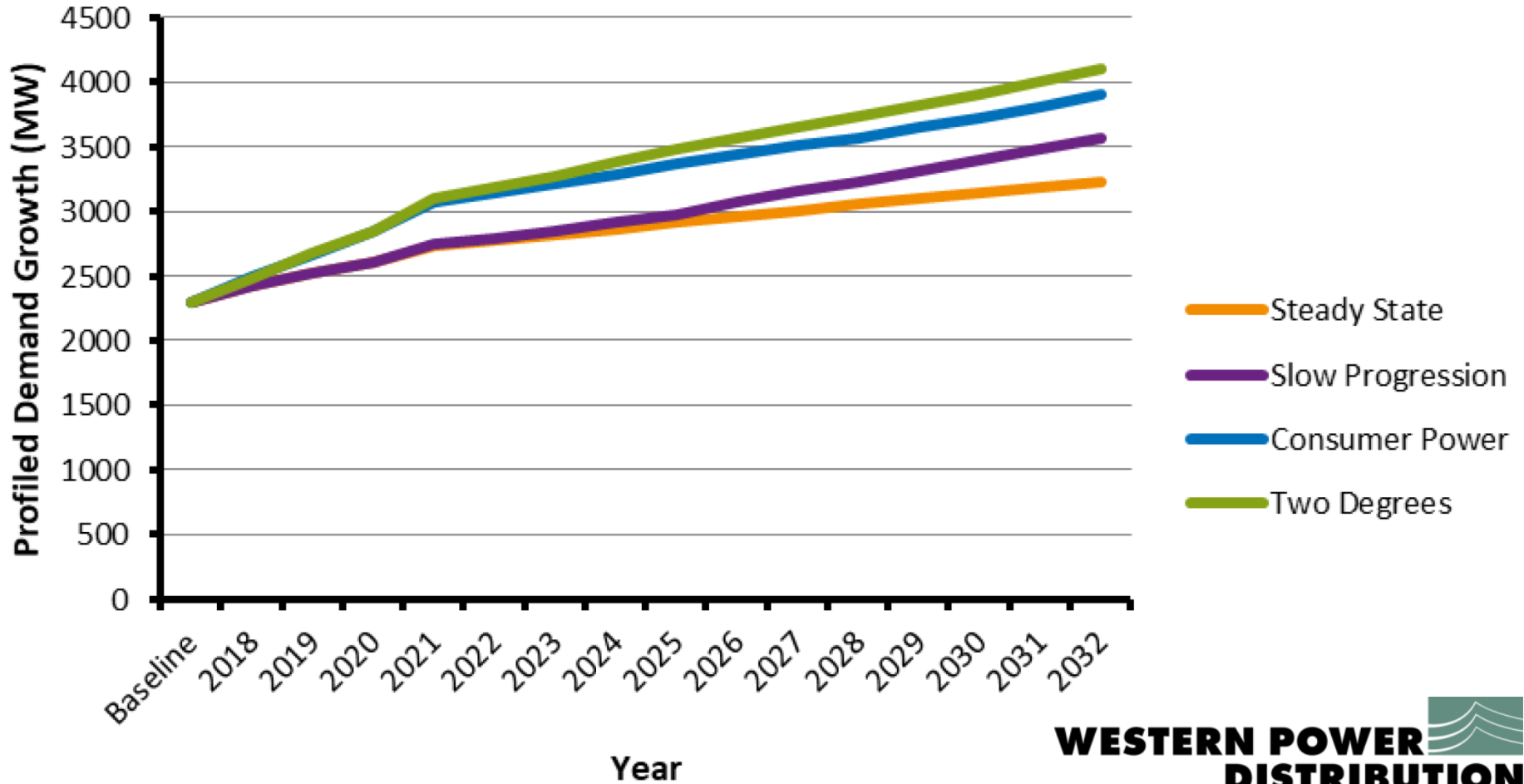
## Constraints/ factors:

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

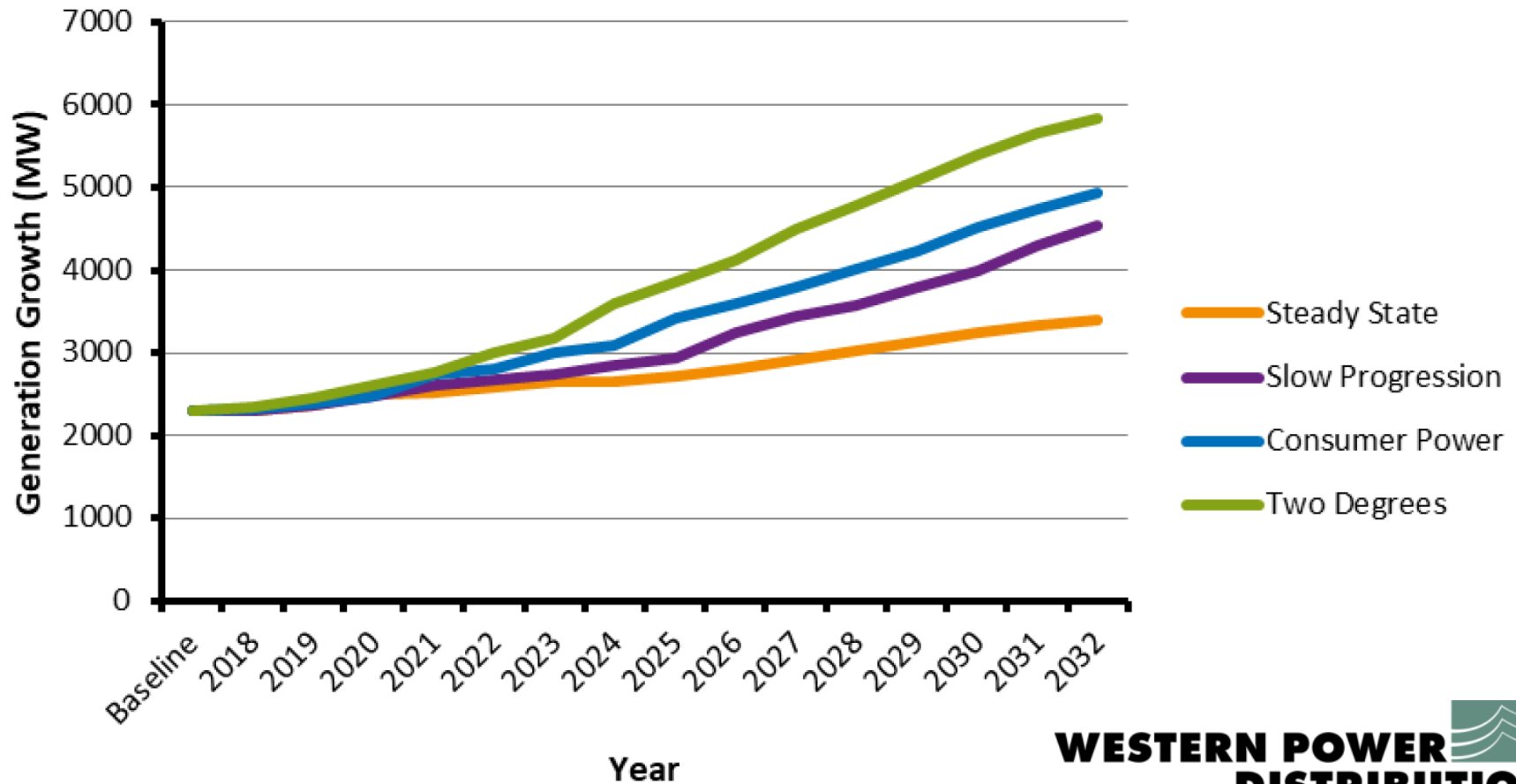
## Apply future energy growth scenarios factors:

- 1) Gone Green
- 2) Consumer Power
- 3) Slow Progression
- 4) No Progression

# Scenarios – Demand Growth

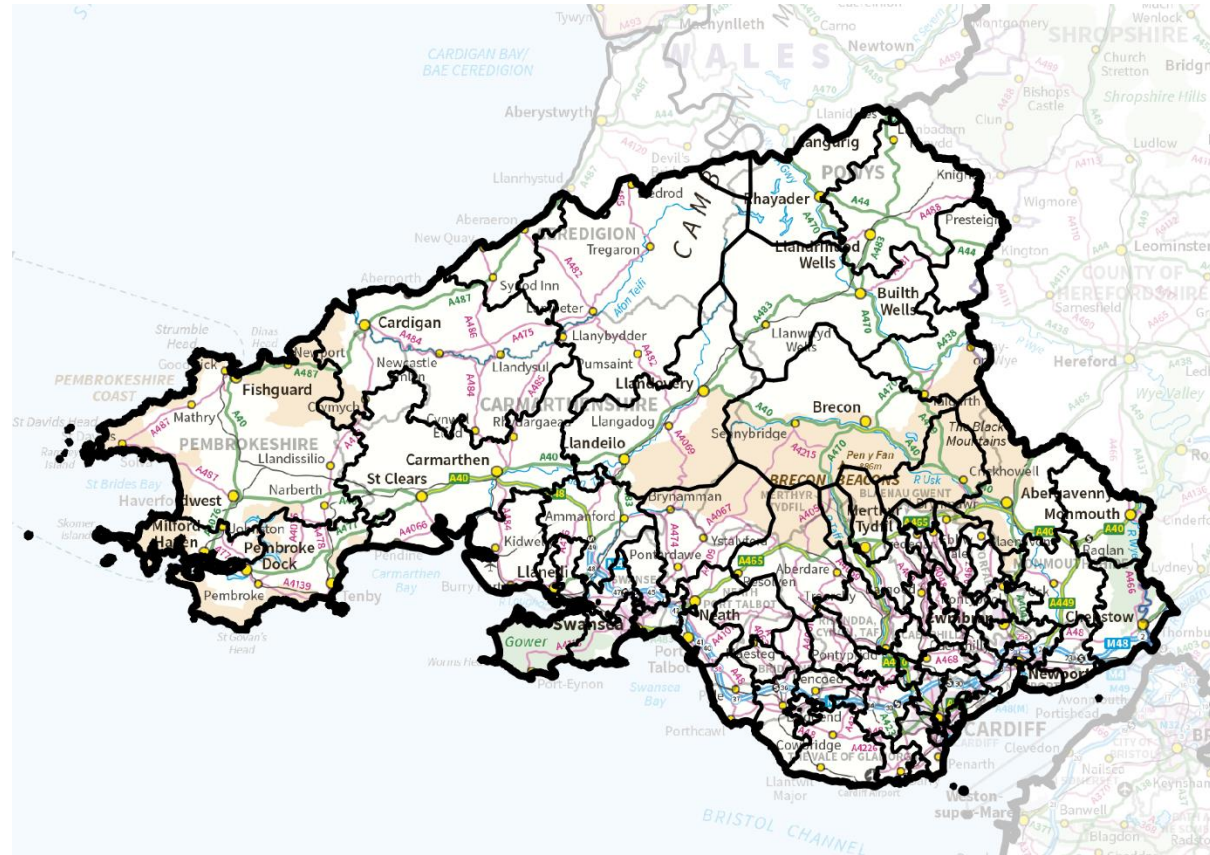


# Scenarios – Generation Growth



# Network modelling

- South Wales divided into Electricity Supply Areas (ESAs):
  - 132/33kV BSPs
  - 132/11kV BSPs
  - 132kV customers
  - 66/11kV primaries
  - 66kV customers
  - Future wind zones
- Scenarios developed at ESA granularity to provide link between geographical position of developments and WPD's network

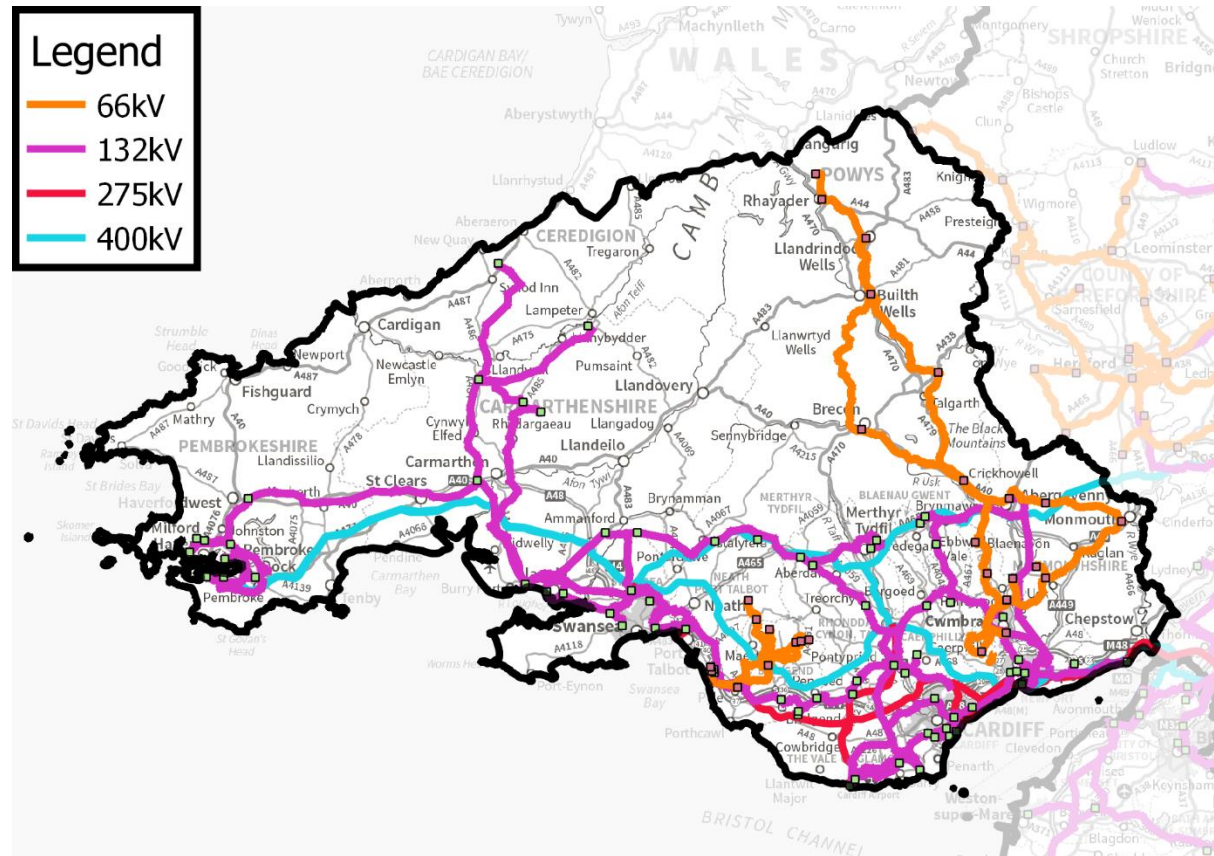


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# Network modelling

- Focus on the subtransmission network consisting of:
  - GSPs (400 or 275kV to 132kV)
  - 132kV network
  - BSPs (132/33kV and 132/11kV)
- 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,
  - Intermediate Warm 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 and then the scenarios for 2022, 2027 and beyond

# New Modelling Techniques

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



Solar dominated networks

Reactive power modelling & optimisation

Demand dominated networks including LCT growth

Advanced contingency routines for analysis of security

Curtailement calculation and energy modelling



# Results Overview

## Demand results at a glance

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

GSP Group	2022				2027			
Pembroke	SS	SP	CP	TD	SS	SP	CP	TD
Swansea North	SS	SP	CP	TD	SS *	SP *	CP *	TD *
Pyle	SS	SP	CP	TD			CP	TD
Margam								
Upper Boat	SS	SP	CP	TD			CP	TD
Aberthaw and Cardiff East	SS	SP	CP	TD	SS	SP	CP	TD
Uskmouth	SS	SP	CP	TD	SS *	SP *	CP *	TD *
Rassau	SS	SP	CP	TD	SS *	SP *	CP *	TD *

\* Swansea North, Uskmouth and Rassau GSPs were not studied in detail against the 2027 scenarios due to the sheer scale of growth in the 2022 scenarios.

# Results Overview

## Generation results at a glance

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

GSP Group	2022				2027			
Pembroke	SS	SP	CP	TD				TD
Swansea North	SS	SP	CP	TD	SS *	SP *	CP *	TD *
Pyle	SS	SP	CP	TD			CP	TD
Margam								TD
Upper Boat				TD				
Aberthaw and Cardiff East	SS	SP	CP	TD	SS	SP	CP	TD
Uskmouth	SS	SP	CP	TD	SS *	SP *	CP *	TD *
Rassau	SS	SP	CP	TD	SS *	SP *	CP *	TD *

\* Swansea North, Uskmouth and Rassau GSPs were not studied in detail against the 2027 scenarios due to the sheer scale of growth in the 2022 scenarios.

# Results – Pembroke GSP



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# Results – Pembroke GSP

## Baseline

Hotspot	Scenario	Trigger	Proposals
A-route 132kV parallel		Ⓜ Generation <b>Demand</b> ↓	Access window assessment
Milford Haven 132kV ring		Ⓜ <b>Generation</b> Demand ↓	Operational management

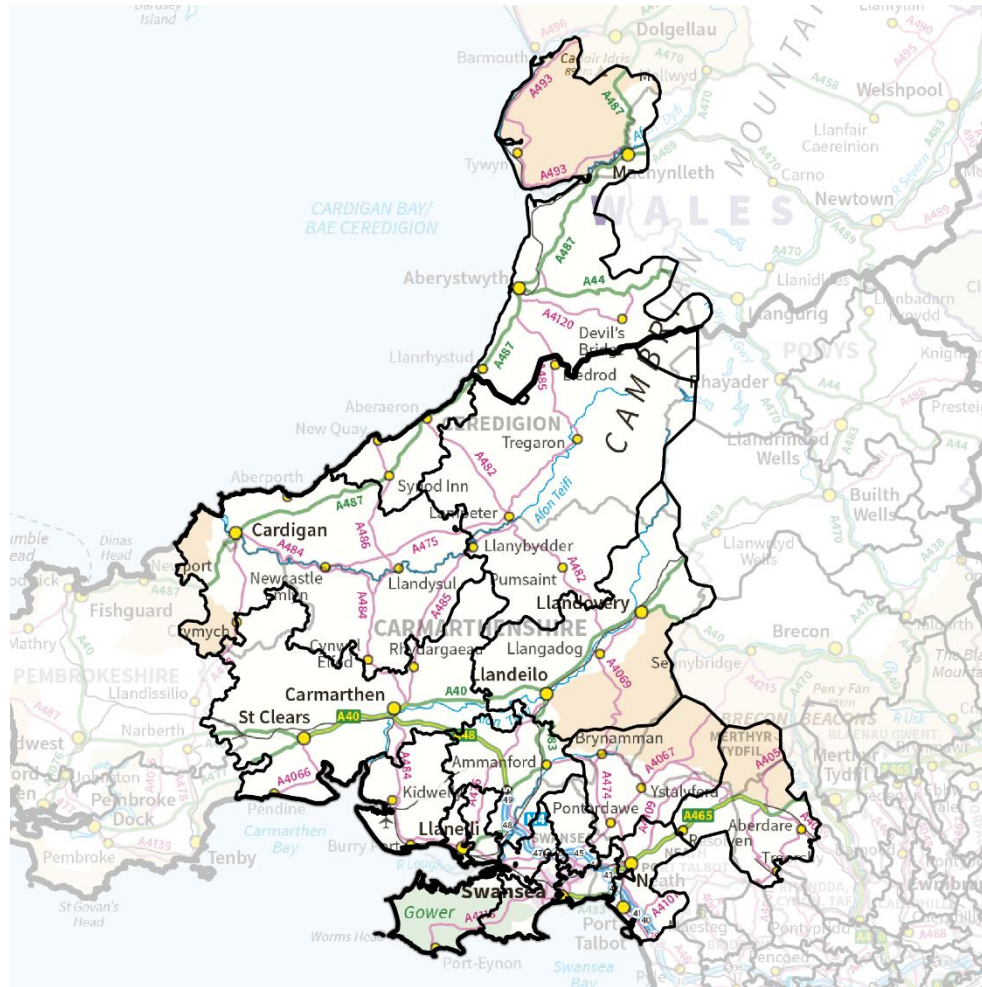
## 2022

Hotspot	Scenario	Trigger	Proposals
SGTs	SS SP CP TD	Ⓜ Generation <b>Demand</b> ↓	Third SGT
Milford Haven 132kV ring	SS SP CP TD	Ⓜ <b>Generation</b> <b>Demand</b> ↓	Fourth 132kV circuit and extra switchgear
Haverfordwest GTs	CP TD	Ⓜ Generation <b>Demand</b> ↓	Split Golden Hill at 33kV for arranged outages
Milford Haven GT	SS SP CP TD	Ⓜ Generation <b>Demand</b> ↓	Replace with 40/60MVA

## 2027

Hotspot	Scenario	Trigger	Proposals
SGTs	SS SP CP TD	Ⓜ Generation <b>Demand</b> ↓	Fourth SGT
All GTs	CP TD	Ⓜ Generation <b>Demand</b> ↓	Second Milford Haven GT and 33kV splits
Milford Haven 132kV ring	CP TD	Ⓜ <b>Generation</b> <b>Demand</b> ↓	Load share control, e.g. series reactor

# Results – Swansea North GSP



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# Results – Swansea North GSP

## Baseline

Hotspot	Scenario	Trigger	Proposals
SGTs		Ⓢ Generation Demand ↓	Access window assessment & operational
A-route 132kV parallel		Ⓢ Generation Demand ↓	Operational management
Carmarthenshire & Ceredigion		Ⓢ Generation Demand ↓	Detailed study including 33kV network

## 2022

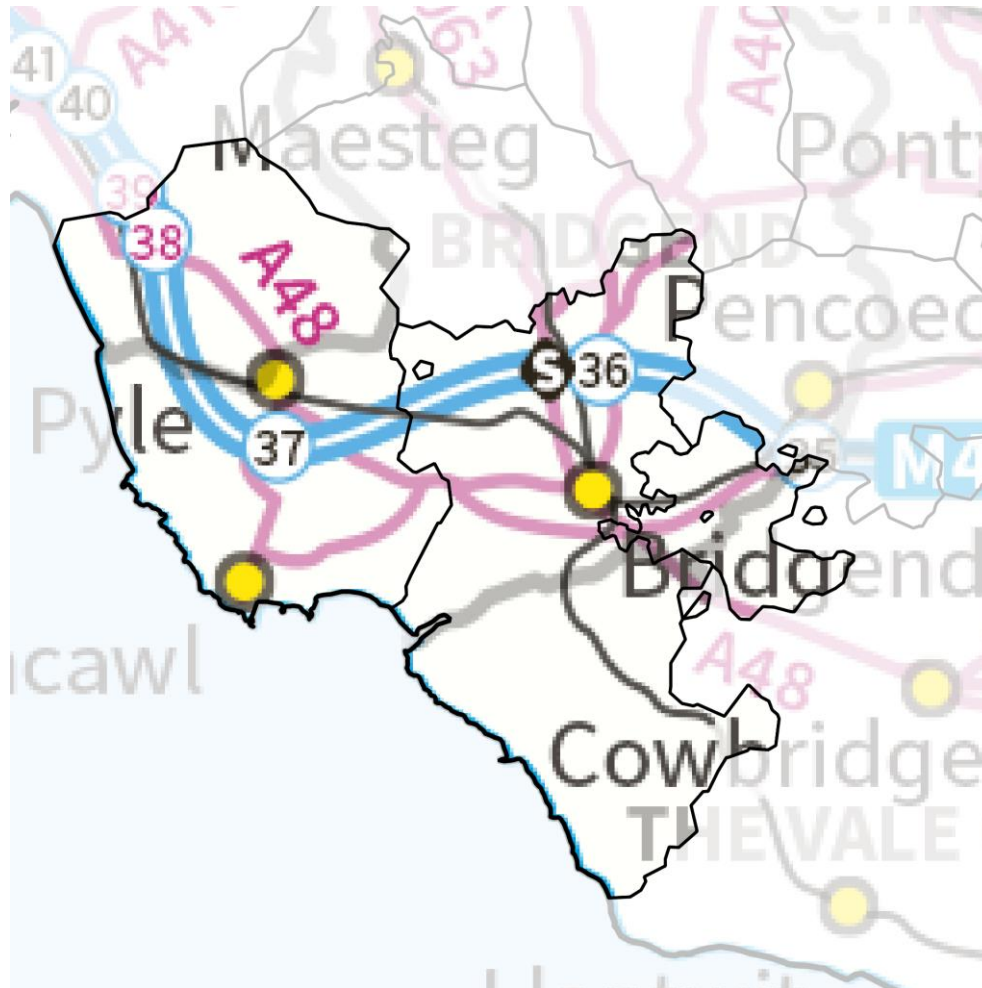
Hotspot	Scenario	Trigger	Proposals
SGTs	SS SP CP TD	Ⓢ Generation Demand ↓	Ferryside GSP
Hirwaun GTs	CP TD	Ⓢ Generation Demand ↓	60/90MVA GTs already triggered
Carmarthenshire & Ceredigion	SS SP CP TD	Ⓢ Generation Demand ↓	3 <sup>rd</sup> 132kV circuit and 2 <sup>nd</sup> GT for Rhos, 33kV splits

## 2027

Not studied due to sheer scale of demand and generation growth






# Results – Pyle GSP





























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# Results – Pyle GSP











## Baseline

Hotspot	Scenario	Trigger	Proposals
GSP 132kV node split		 <b>Generation</b>  <b>Demand</b> 	Operational management: Swansea North parallel?

## 2022

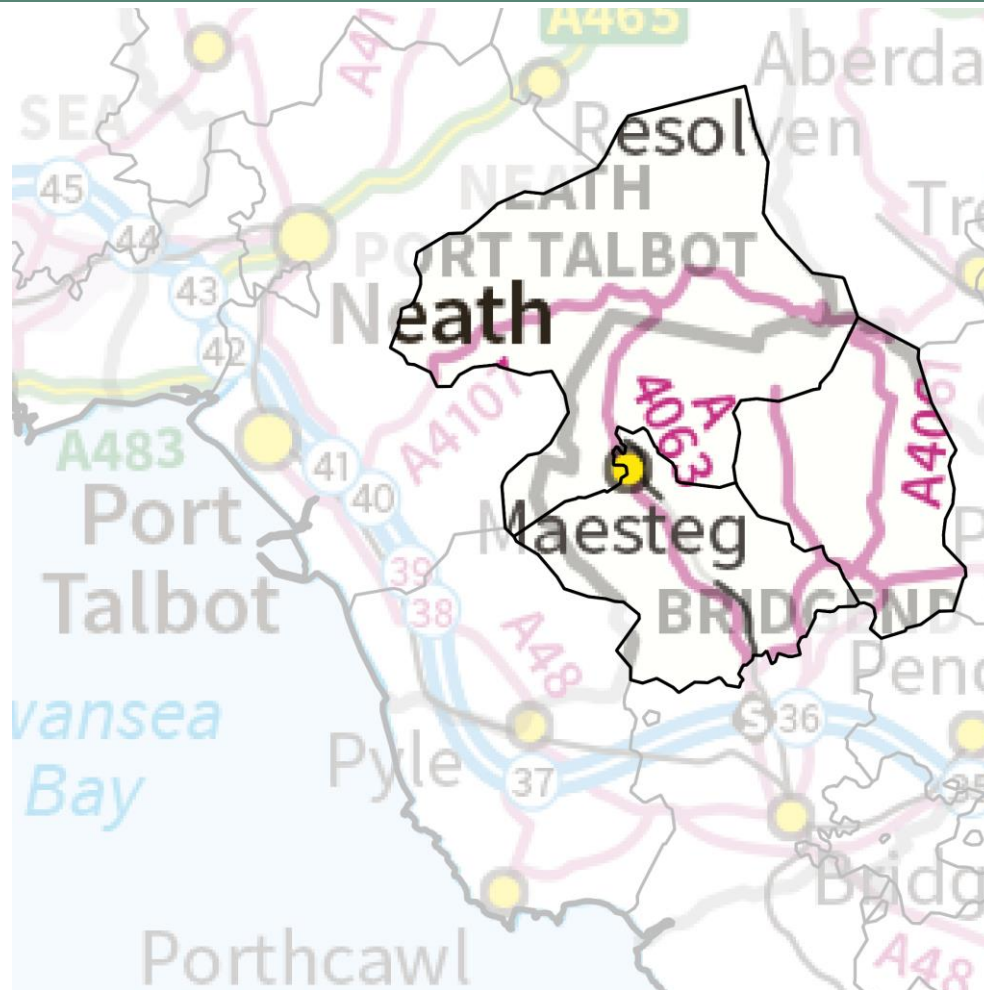
Hotspot	Scenario	Trigger	Proposals
SGTs	   	 <b>Generation</b>  <b>Demand</b> 	Replace 180MVA SGT1 with 240MVA
Bridgend GTs & U-route	   	 Generation  <b>Demand</b> 	Replace with 60/90MVA, overlay 132kV cable
Upper Boat transfers	   	 Generation  <b>Demand</b> 	Reassess transfer capacity
GSP 132kV node split	 	 <b>Generation</b>  Demand 	Curtail generators or fit bus section breaker 320

## 2027

Hotspot	Scenario	Trigger	Proposals
SGTs	 	 <b>Generation</b>  <b>Demand</b> 	Third SGT & through-flow study with National Grid
Bridgend GTs	 	 Generation  <b>Demand</b> 	Transfer demand to Waterton Industrial BSP





















# Results – Margam GSP



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# Results – Margam GSP

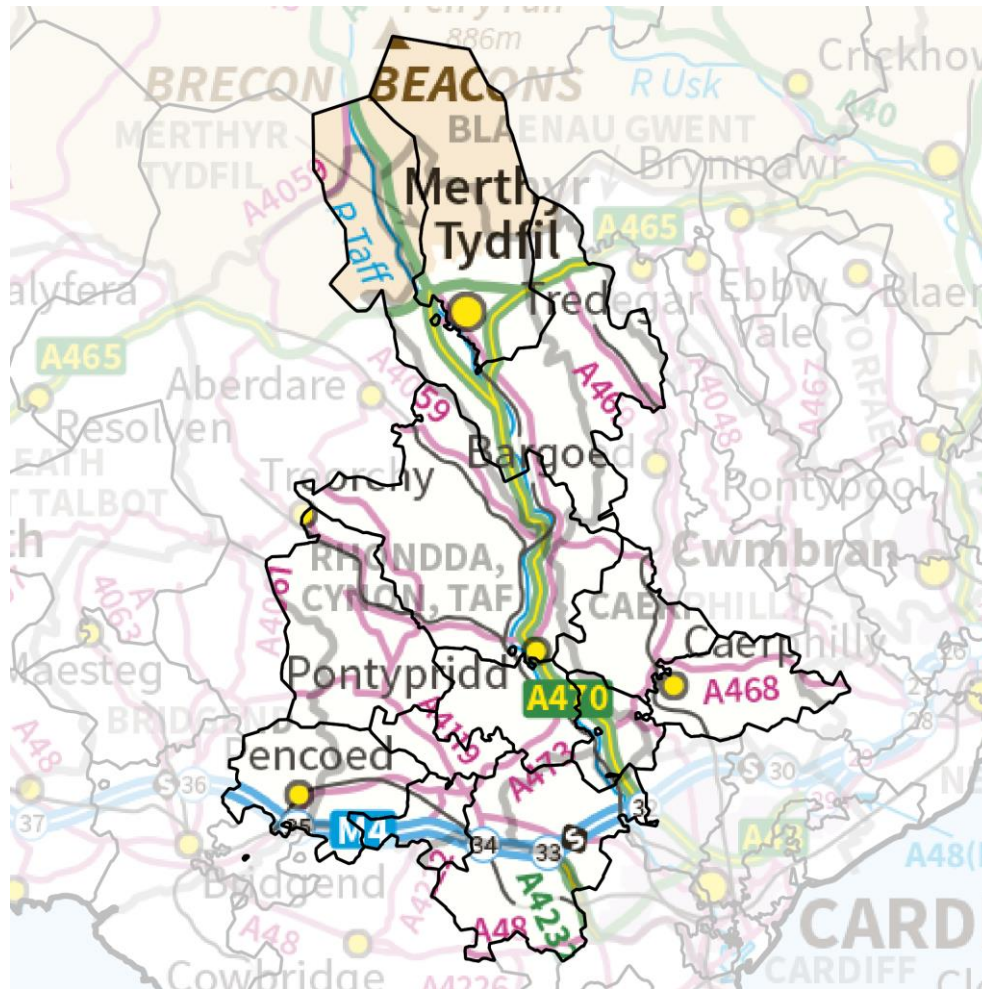
## Baseline

Hotspot	Scenario	Trigger	Proposals
SGT 66kV interplants		 <b>Generation</b>  <b>Demand</b> 	Confirm ratings with National Grid
GTs & 66kV interplants		 <b>Generation</b>  <b>Demand</b> 	Discontinue Margam BSP parallel operation
Grange → Cefn Gwrgan		 <b>Generation</b>  <b>Demand</b> 	Overlay interconnector A, discontinue parallel
Llynfi Valley voltage		 <b>Generation</b>  <b>Demand</b> 	Revise AVC settings, reactive compensation
Llynfi Valley thermal		 <b>Generation</b>  <b>Demand</b> 	Reprofiling already triggered
Llynfi Valley intertripping		 <b>Generation</b>  <b>Demand</b> 	Extend schemes to cover busbar faults

## 2027

Hotspot	Scenario	Trigger	Proposals
Llynfi Valley 66kV circuits		 <b>Generation</b>  <b>Demand</b> 	Reprofile & reconductor overheads, overlay cables

# Results – Upper Boat GSP



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# Results – Upper Boat GSP

## Baseline

Hotspot	Scenario	Trigger	Proposals
132kV busbar splits		Generation  Demand	Operational management: splits & transfers
Pyle transfers		Generation  Demand	Access window assessment
275/33kV SGTs		Generation  Demand	Access window assessment
Dowlais GTs		Generation  Demand	Assess transformer ageing

## 2022

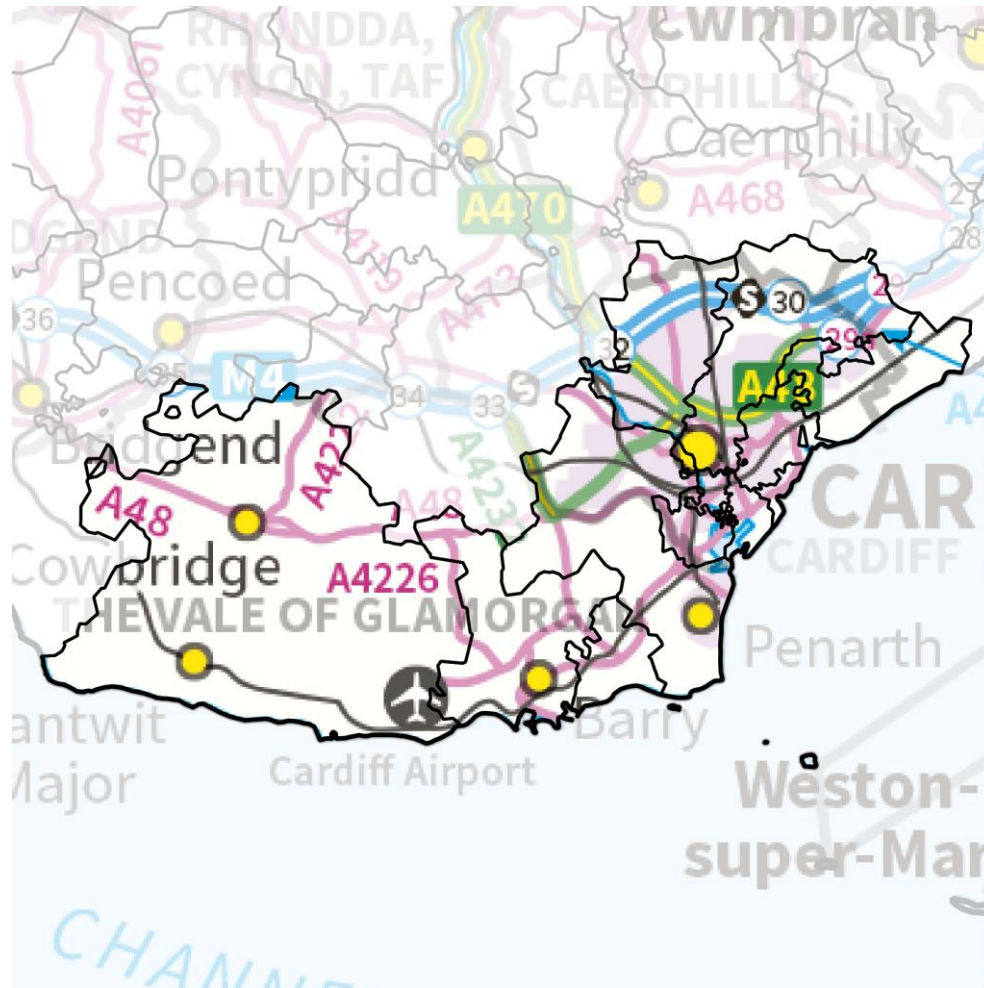
Hotspot	Scenario	Trigger	Proposals
275/33kV SGTs	SS  SP  CP  TD	Generation  Demand	2 <sup>nd</sup> GT at Mountain Ash, 33kV split, new switchgear
D-, Y-, & YE-route 132kV	SS  SP  CP  TD	Generation  Demand	Reprofile or reconductor overhead lines
275/132kV SGTs	SS  SP  CP  TD	Generation  Demand	New running arrangements, short-term ratings
Pyle & Swansea North transfers	SS  SP  CP  TD	Generation  Demand	Restrict transfers
Merthyr East GTs	SS  SP  CP  TD	Generation  Demand	Transfer load to new primary on Dowlais BSP

# Results – Upper Boat GSP

2027

Hotspot	Scenario	Trigger	Proposals
Dowlais GTs	CP	Generation Demand	Replace with 40/60MVA or transfers to Merthyr East
275/33kV SGTs & Mountain Ash GTs	TD	Generation Demand	Replace Mountain Ash GTs with 60/90MVA
D-, Y-, & YE-route 132kV	CP TD	Generation Demand	Reconductor overhead lines

# Results – Aberthaw & Cardiff East



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# Results – Aberthaw & Cardiff East

## Baseline

Hotspot	Scenario	Trigger	Proposals
Load-share/through-flow		⚡ Generation Demand ↓	Improve models, detailed study with National Grid
BSP 132kV node splits		⚡ Generation Demand ↓	Offload a GT for section/coupler maintenance
Cardiff East/North GTs		⚡ Generation Demand ↓	Access window assessment
Barry/East Aberthaw GTs		⚡ Generation Demand ↓	Access window assessment

## 2022

Hotspot	Scenario	Trigger	Proposals
East Aberthaw rapid demand growth	SS SP CP TD	⚡ Generation Demand ↓	Scenarios challenge and review/vast reinforcement
Cardiff West/Central GTs	SS SP CP TD	⚡ Generation Demand ↓	2 <sup>nd</sup> 90MVA GT at Cardiff Central, split 33kV
Cardiff East/North GTs	SS SP CP TD	⚡ Generation Demand ↓	Access window assessment

## 2027

Hotspot	Scenario	Trigger	Proposals
Load-share/through-flow	SS SP CP TD	⚡ Generation Demand ↓	Improve models, major reinforcement expected
Cardiff East/North GTs	CP	⚡ Generation Demand ↓	2 <sup>nd</sup> 90MVA GT at Cardiff North, split 33kV

# Results – Uskmouth GSP



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# Results – Uskmouth GSP

## Baseline

Hotspot	Scenario	Trigger	Proposals
132kV series reactor		Ⓢ Generation Demand ↓	Access window assessment/confirm auto-close
Pontypool North couple		Ⓢ Generation Demand ↓	Operational management
Llantarnam backfeed		Ⓢ Generation Demand ↓	Operational management

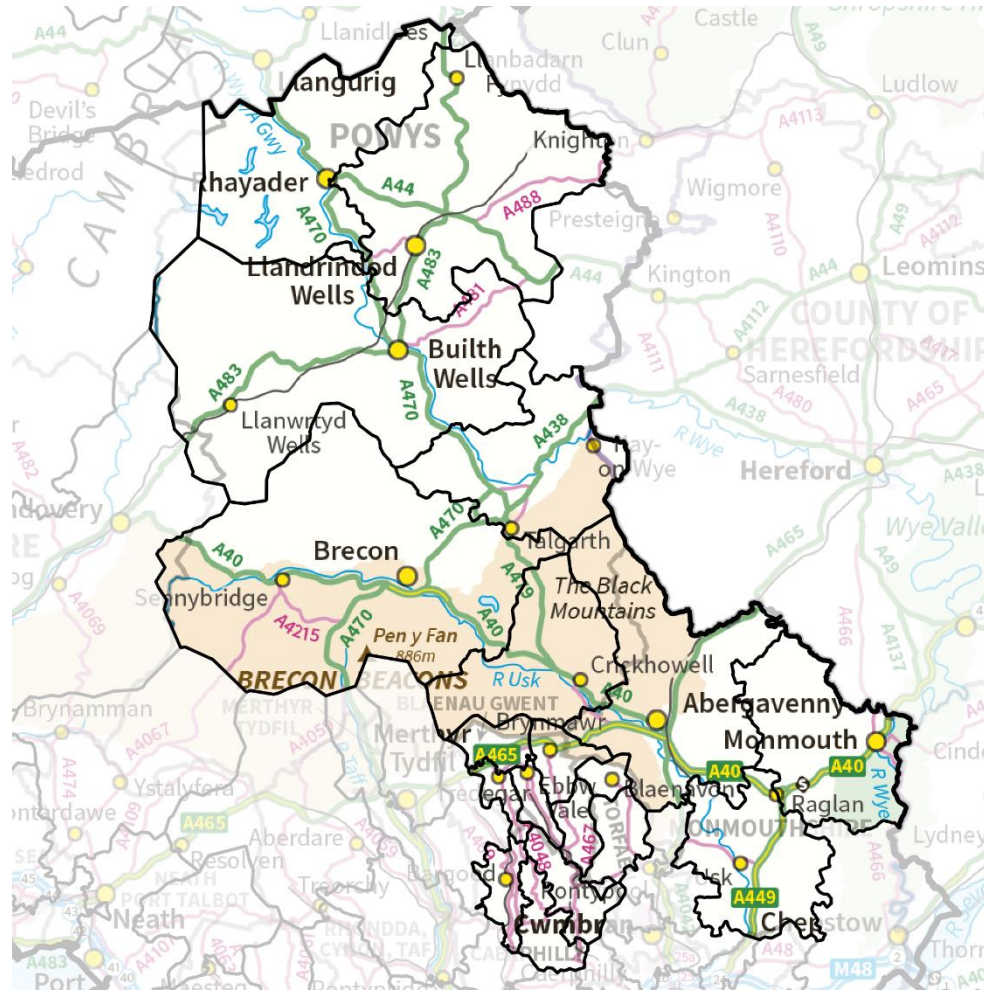
## 2022

Hotspot	Scenario	Trigger	Proposals
SGTs	SS SP CP TD	Ⓢ Generation Demand ↓	Short-term ratings/transfers to Rassau
132kV busbar fault	TD	Ⓢ Generation Demand ↓	SGT short-term ratings
Magor GTs	CP TD	Ⓢ Generation Demand ↓	New BSP near Llanwern
Newport West BSP	CP TD	Ⓢ Generation Demand ↓	Transfer load to new primary on Newport South BSP
Newport South BSP	SS SP CP TD	Ⓢ Generation Demand ↓	New primary on 33kV, third incoming 132kV circuit
Panteg BSP 132/11kV	SS SP CP TD	Ⓢ Generation Demand ↓	Transfer load to Cwmbran BSP

## 2027

Not studied due to sheer scale of demand and generation growth

# Results – Rassau GSP



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# Results – Rassau GSP

## Baseline

Hotspot	Scenario	Trigger	Proposals
Ebbw Vale backfeed		Generation  Demand	Operational management or intertrip
Crumlin backfeed		Generation  Demand	Operational management
132kV P18		Generation  Demand	Bring into line during future works
Abergavenny GT1		Generation  Demand	Switch southern 66kV ring to Uskmouth for arranged
Abergavenny → Monmouth 66kV		Generation  Demand	Switch southern 66kV ring to Uskmouth for arranged
Builth Wells		Generation  Demand	Review intertripping, manage splits operationally
66kV low volts		Generation  Demand	Capacitors already triggered/operational

## 2022

Hotspot	Scenario	Trigger	Proposals
Whole network		Generation  Demand	Scenarios challenge and review/vast reinforcement

## 2027

Not studied due to sheer scale of demand and generation growth

# Results – Summary

- Network constraints driven by both demand and generation growth
- Many operational actions are already in place to manage effects of increased DG and demand.
- Most networks will need some intervention, possibly as soon as 2022
- Flexibility available to manage unpredictable growth, backed up by long-term build solutions identified in report
- Some networks will remain untouched except operational interventions
- Reinforcements identified will need to be implemented in line with the uptake trajectory for new demand
- Joint modelling with SP Manweb and National Grid recommended in some areas

# 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 precede reinforcement where flexibility is likely to be most economic

[www.westernpower.co.uk/signposting](http://www.westernpower.co.uk/signposting)

[www.flexiblepower.co.uk](http://www.flexiblepower.co.uk)

# Looking to the Future

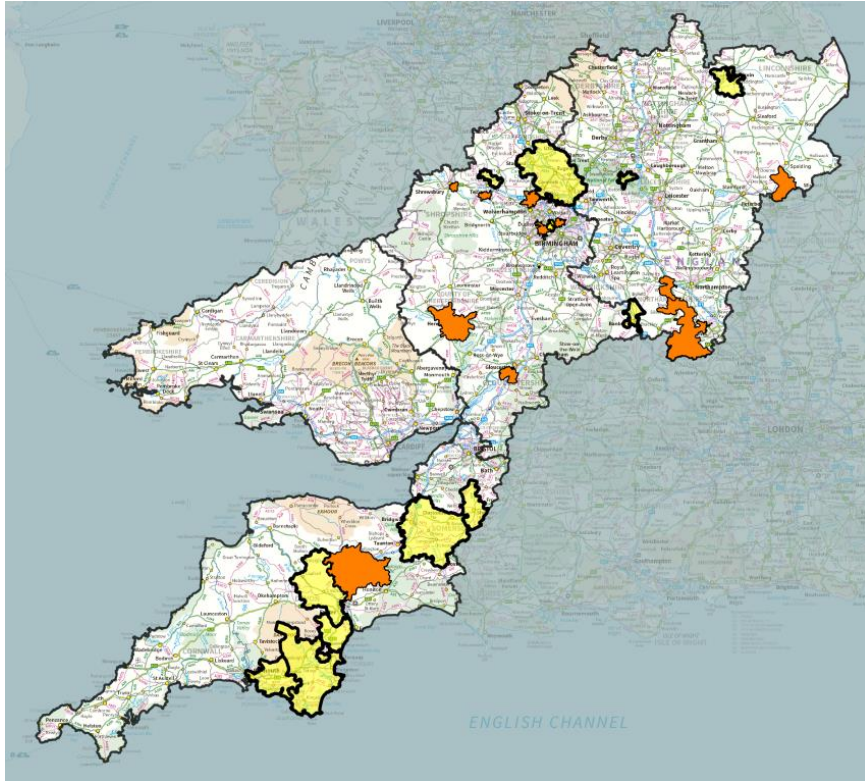
- WPD has updated its DSO Strategy document following customer and stakeholder feedback:

<https://www.westernpower.co.uk/About-us/Our-Business/Our-network/Strategic-network-investment/DSO-Strategy.aspx>





# Looking to the Future



- Rolling out flexibility services across WPD
- Marketed as Flexible Power
- 3 new DSR services
  - Secure
  - Dynamic
  - Restore
- Pre and Post Fault constraint resources
- 93.4MW required
- Across 80 Primary substations
- Affects over £25m of reinforcement
- Second round in July/August



[www.flexiblepower.co.uk](http://www.flexiblepower.co.uk)

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# Looking to the Future

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

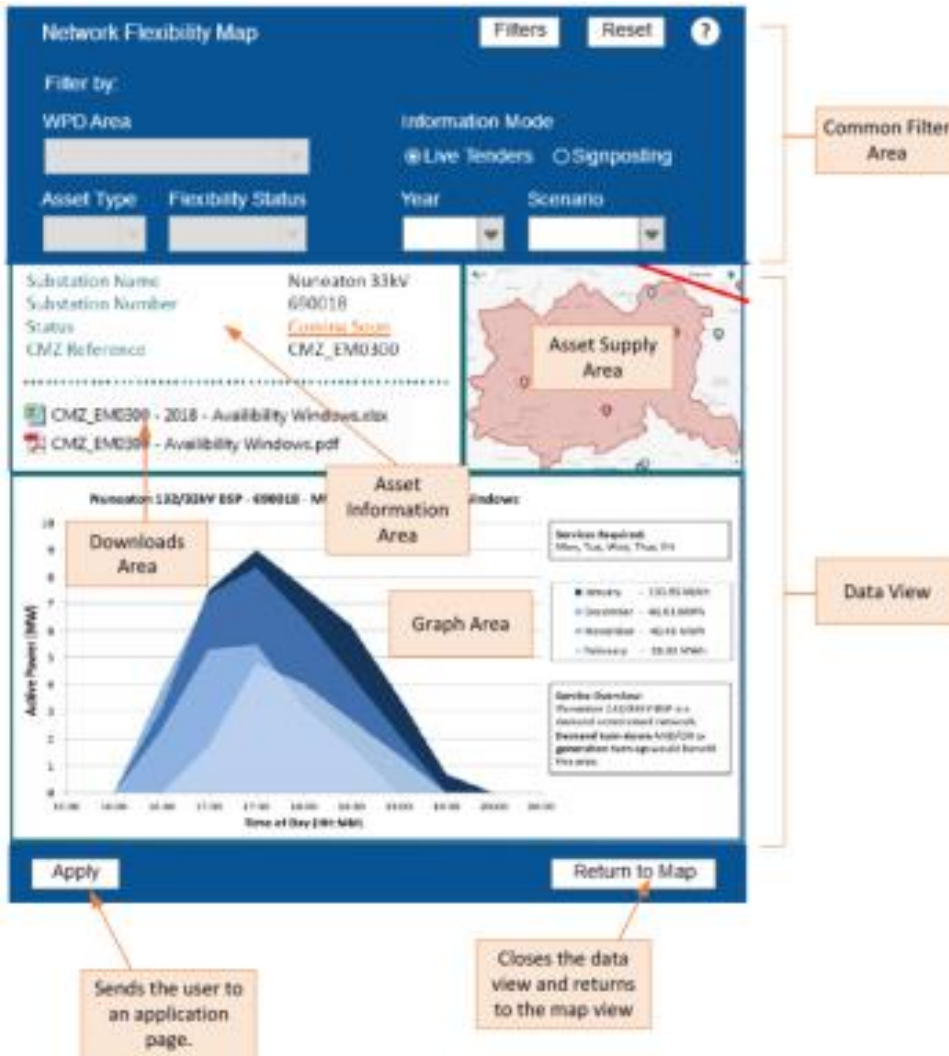
[www.westernpower.co.uk/network-flexibility-map](http://www.westernpower.co.uk/network-flexibility-map)

This displays information on:

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

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# Summary

- We are now on 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 WPD's 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

# 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?

# 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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