Shaping Subtransmission to 2030

South West

July 2016

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Objective

- Forecast growth of demand and generation over 4 economic scenarios
- Assess the thermal and voltage constraints under these scenarios that will limit the ability of those 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 2.5GW and minimum demand of 0.98GW
- Unprecedented growth of DG in South West:

	Connected [MVA]	Accepted [MVA]	Offered [MVA]	Total [MVA]
Solar PV	1,186	443	58	1,687
All Generation	1,961	910	1,097	3,968

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 the F-route constraint 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

- Published after the work on this study was complete, some key messages are:
- Whilst sufficient progress (in low carbon generation) has been made to meet the committees 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*'

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Scenarios

- Growth of DG and new demand (HPs and EVs) in South West forecast by Regen SW from 2015 to 2030
- Four scenarios corresponding to NGT FES:
  - Gone Green
  - Consumer Power
  - Slow Progression
  - No Progression
- Forecast at a 132/ 33kV substation granularity to allow analysis

nationalgrid

FES 2015

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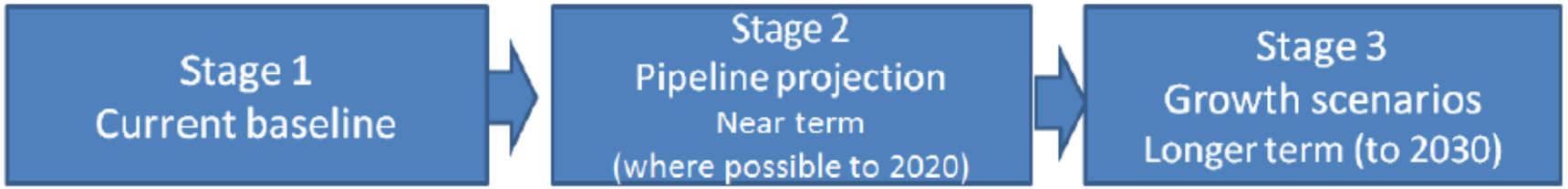
Scenarios – methodology



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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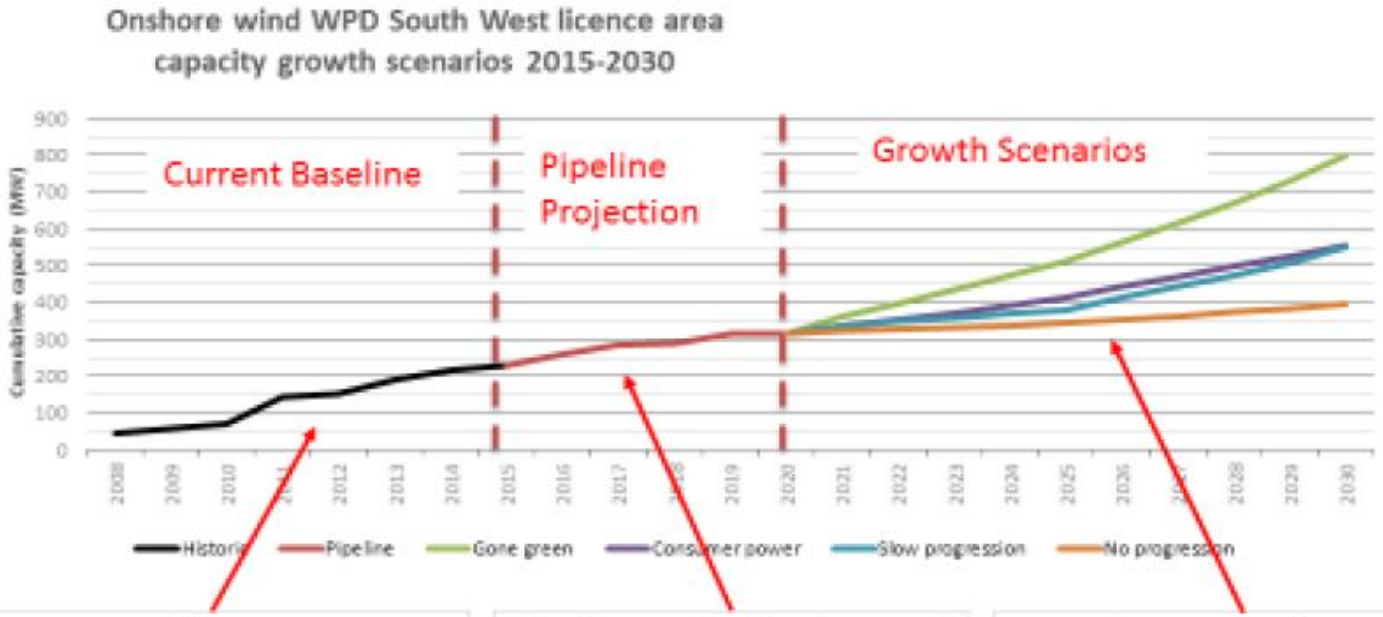
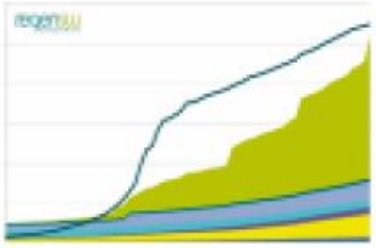
Scenarios - example



Current Baseline - progress to
late taken from extensive
egen SW DG project database



Pipeline Projection (to 2020)
Analysis of current projects in the planning system and with grid connection agreements. Uplift on additional smaller projects estimated.

Growth Scenarios (to 2030) - Growth dependent on FES scenarios:

- **Consumer Power**
- **Gone Green**
- **Slow Progression**
- **No Progression**

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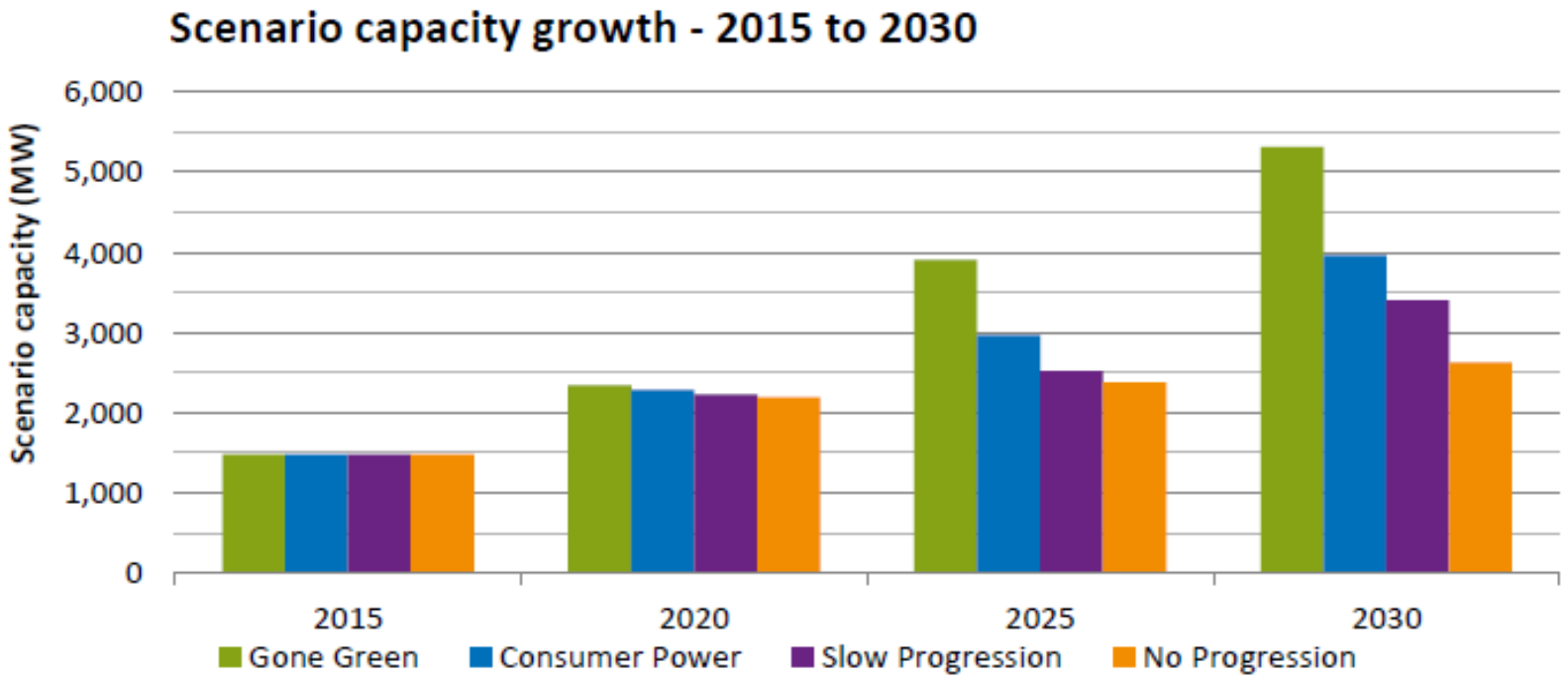
Scenarios – DG Growth



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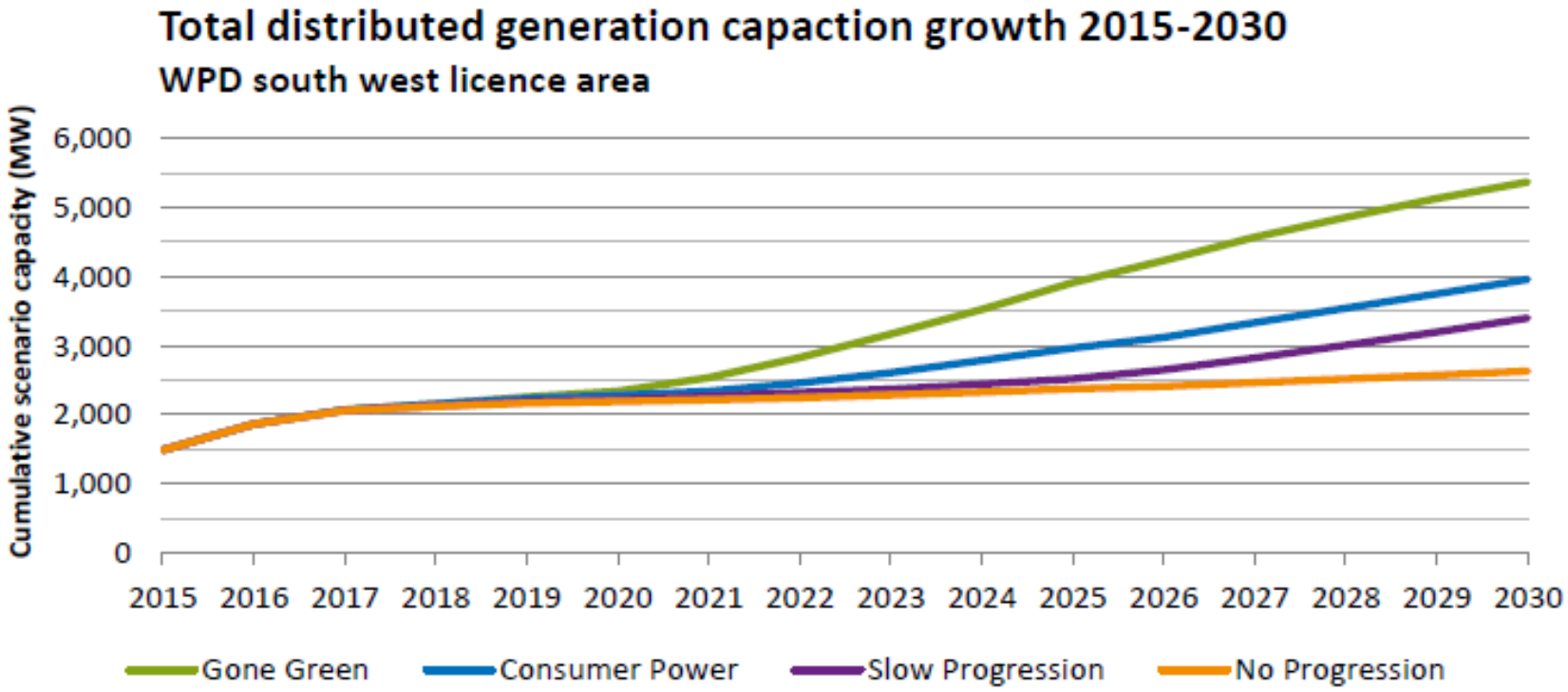
Scenarios – DG Growth



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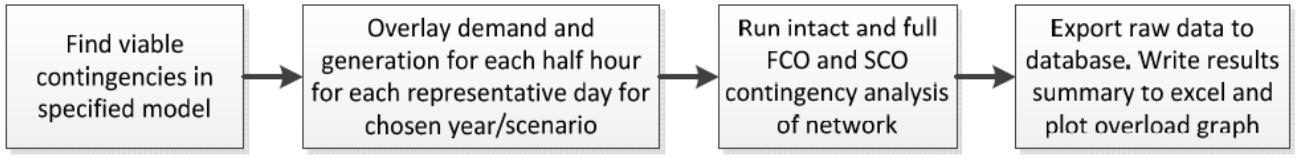
Network modelling

- Focus on the subtransmission network consisting of:
  - GSPs (400/132kV and 275/132kV)
  - 132kV network
  - BSPs (132/33kV and 132/11kV in S West)
- Previous analysis has focused on the expected peak/minumum demand conditions. This study modelled each half-hour for:
  - Summer day (DG dominated)
  - Winter day (demand dominated)
  - Typical spring/autumn day
  - For both first and second circuit outages
- Profiles of generation/demand were determined using a combination of historic data logging data modified for technology additions according to the scenario
- Analysis was undertaken for the baseline of 2015 and then the scenarios for 2020 and 2025



Results

- Whilst not an objective of the study, it did allow us to confirm the validity of some reinforcements currently underway:
  - F-route – split of 132kV circuit
  - Fraddon BSP – additional transformer capacity and circuit upgrades
  - J-route – circuit re-crimping to uprate
- New reinforcement requirements identified:
  - Alverdiscott/Indian Queens (K-route)
  - Abham/Exeter/Landulph GSP group and 132kV interconnection
  - 132kV circuit from Marsh Barton power station to Sowton tee-off
  - Landulph/St Germans BSP group and associated 132kV circuits
  - 132kV circuit from Indian Queens to St Germans/St Austell tee
  - Pyworthy/North Tawton BSP group

Reinforcement and ANM

- ANM can avoid expensive reinforcement, however:
  - 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 the S West
- To understand the transmission issues that would arise under the scenarios we have:
  - Improved the exchange of network data between WPD and NGET including trailing a revised Statement of Works process, and
  - Agreed that NGET will undertake detailed studies on the impact of our scenarios on the transmission network
- We have also started detailed discussions with NGT on the future planning and operation of the combined transmission and distribution network in the S West (as part of a National Grid work stream on the future role of the system operator (FRSO))

Recommendations

- Pursue additional 2020 reinforcement:
  - K-route and GSP capacity in the Indian Queens/Alverdiscott GSP group including consideration of an additional GSP in the Pyworthy area
  - Detailed consideration of the following networks:
    - 132kV circuit from Marsh Barton power station to Sowton tee-off;
    - Landulph/St Germans BSP group and associated 132kV circuits;
    - 132kV circuit from Indian Queens to St Germans/St Austell tee;
    - Pyworthy/North Tawton BSP group; and
    - Abham/Exeter/Landulph GSP group.
- Revisit studies once further assessment completed by National Grid
- Further work on the technical limits of ANM
- Consider future 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 (e.g. F route, Fraddon and K route) 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. A method/process is needed to demonstrate where reinforcement is economic i.e. where is ANM appropriate and when is reinforcement needed
- 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. Is this the right long term policy?
- 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, the areas being assessed are:

Subject	Notes
ASCs	At what point will we need to replace ASC earthing in Cornwall?
Fault level	What problems will rising fault levels cause (e.g. protection, switchgear stressing)? What problems will falling fault levels cause (e.g. protection, system stability, power quality)?
Vector shift protection	System stability - vector shift (coordination of G59 protection with generator behaviour and network requirements)
ANM	What are the limitations of current and anticipated ANM systems? What are the limitations of our networks when managed by ANM systems? How will our ANM interact with NGET's?
Voltage control	Does negative-reactance compounding work effectively any more? Is line-drop compensation helpful in mixed demand and DG networks? Do we need to complement transformer tap-changer voltage control with reactive voltage control - should we run some DG for voltage control? Will NG always be able to provide voltage control towards DNO networks?
Dispatch and outage coordination	Better methods for communicating notice of constraints are being developed along with methods for feedback on the impact of these constraints
LFDD	To what extent are generation dominated networks degrading LFDD?
Network monitoring and modelling	What additional monitoring of the network is required? What further modelling capability needs to be added?

Summary

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

Further information/contact details

- Reports/presentations are available from:

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

- Questions/enquiries via:

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