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Optimal Coordination of Active Network Management Schemes and Balancing Services Market

Final dissemination webinar

2 June 2021

Objective of session

- Provide an overview of the project and high-level findings
- Signpost where more detailed information is available
- Take questions and/or comments from stakeholders

Practicalities

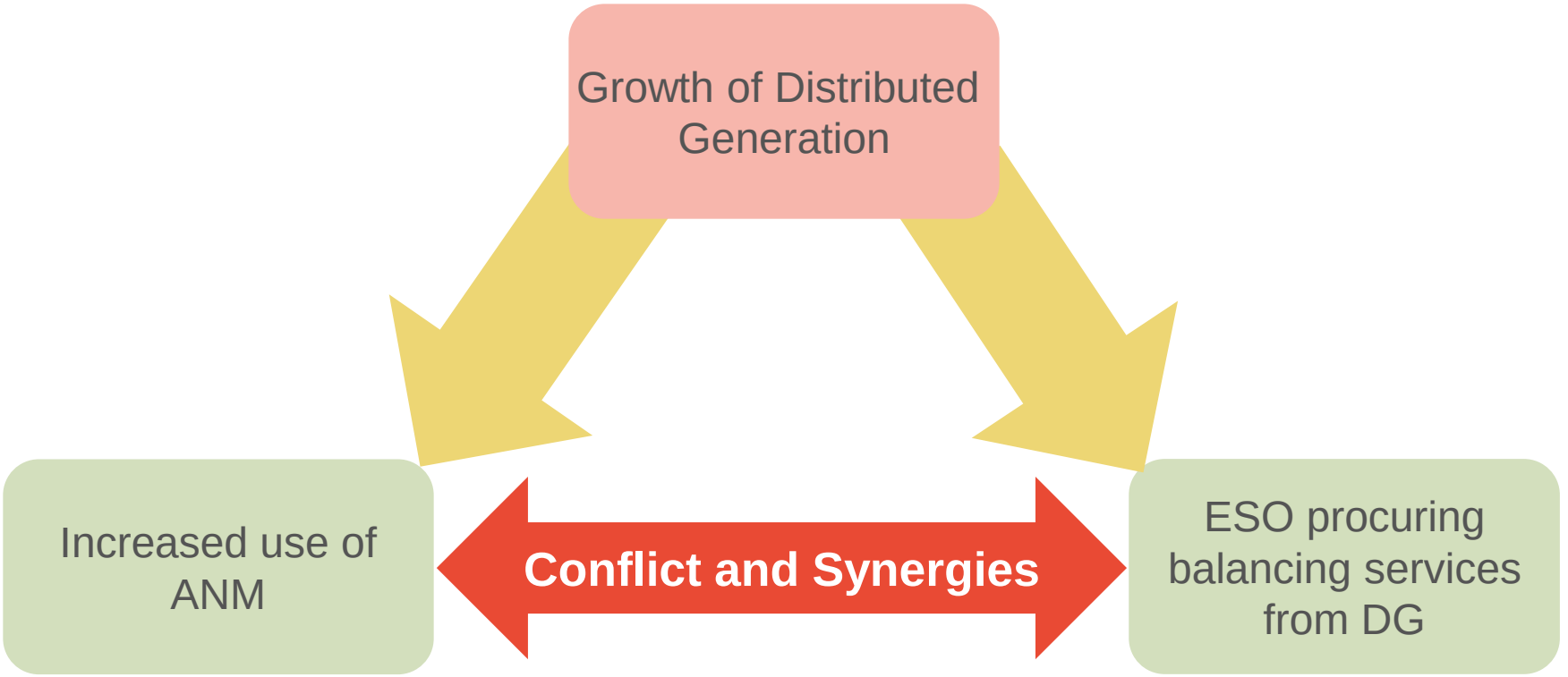
- You have joined the webinar in listen-only mode
- Please:
  - Raise questions and comments via the chat function at any time
  - Provide any further comments by email to any of the project team during or after the meeting
    - See final slide for contact details
- The webinar is being recorded and slides will be published after the session

Agenda

Time	Item	Lead
15:00-15:10	Introductions and project overview	Andrew Enzor, Cornwall Insight
15:10-15:15	Current and future ANM schemes	Tom Goswell, Cornwall Insight
15:15-15:25	Test cases and solutions	Manuel Castro, WSP Abdullah Emhmed, WSP
15:25-15:35	Commercial assessment of solutions	Tom Goswell, Cornwall Insight
15:35-15:45	Implementing solutions	Vince Goode, Complete Strategy Stuart Cook, Complete Strategy
15:45-15:55	Remarks from WPD and NG ESO, next steps	Jenny Woodruff, WPD Tolulope Esan, NG ESO
15:55-16:00	Q&A, wrap-up and close	Andrew Enzor, Cornwall Insight

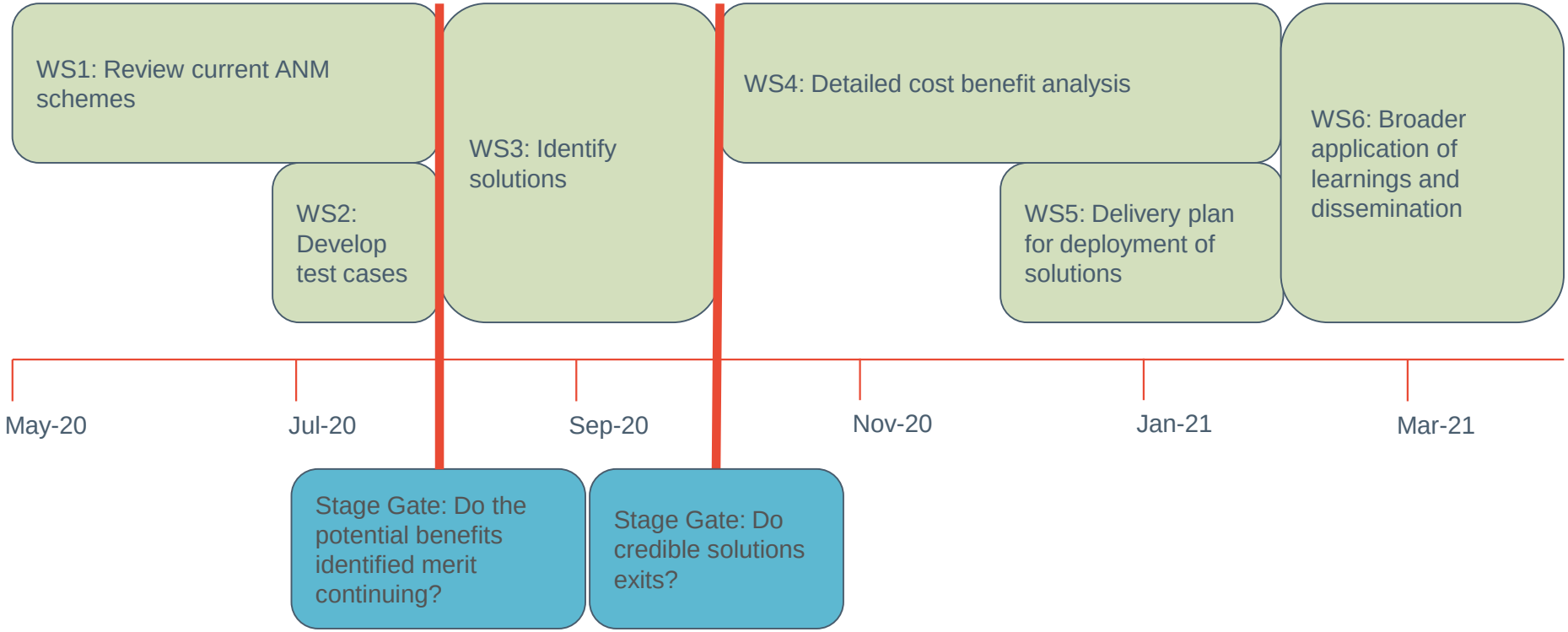
Introductions and project overview

Problem definition



Problem Statement:
ANM schemes which are not coordinated with wider Balancing Services markets will increase costs to consumers and may pose a risk to security of supply

Project structure



- Published reports align with the workstreams as set out here
- Links throughout the slides to the relevant report and at the end

Key findings

- Risks of uncoordinated ANM / Balancing Services to security of supply and consumer costs are material
- There are feasible solutions to the coordination issues, including:
  - Reconfiguration of ANM schemes
  - Better information exchange including curtailment forecasts
  - Changes to Balancing Services procurement by NG ESO
- Conservative assumptions give benefits of £40m - £120m per year
- Actions to assist implementation include establishing comms links and improving forecasting
- Action should be taken now given impending business plans for RIIO-ED2

- Full findings in WS6 report: https://www.westernpower.co.uk/downloads-view-reciteme/336778

Current and future ANM schemes

ANM can enable new connections within existing constraints

Dynamic management of Distributed Energy Resources behind constraints to optimise utilisation of network assets without breaching operational limits, primarily to reduce the need for reinforcement driven by new connections, speed up associated connection times and reduce connection costs

- ANM-like technology may be used in the future to manage procured flexibility…
- …but we are deliberately focused on ANM used to connect DER without reinforcement to speed up connection timescales and reduce consumer costs

- ANM definition and background in WS1/2 report: https://www.westernpower.co.uk/downloads-view/206443

Summary by DNO

DNO	Volume of ANM Generation (MW)	Planned Development
SPEN	150	Dumfries and Galloway wide area scheme managing interacting transmission and distribution constraints. Transmission ANM being developed which will manage transmission constraints
SSEN	175	South West Operational Tripping Scheme will result in nine GSPs in the Southern region (~60% of the area) being managed by ANM
ENWL	770	Licence area wide scheme planned
NPg	950	Further schemes as needed. Latest system is fully scalable
UKPN	1,725	Further schemes in development
WPD	2,945	High volume of accepted offers in ANM-managed areas likely to increase curtailment
Total	**6,715**	

- Current use of ANM in full in WS1/2 report: https://www.westernpower.co.uk/downloads-view/206443

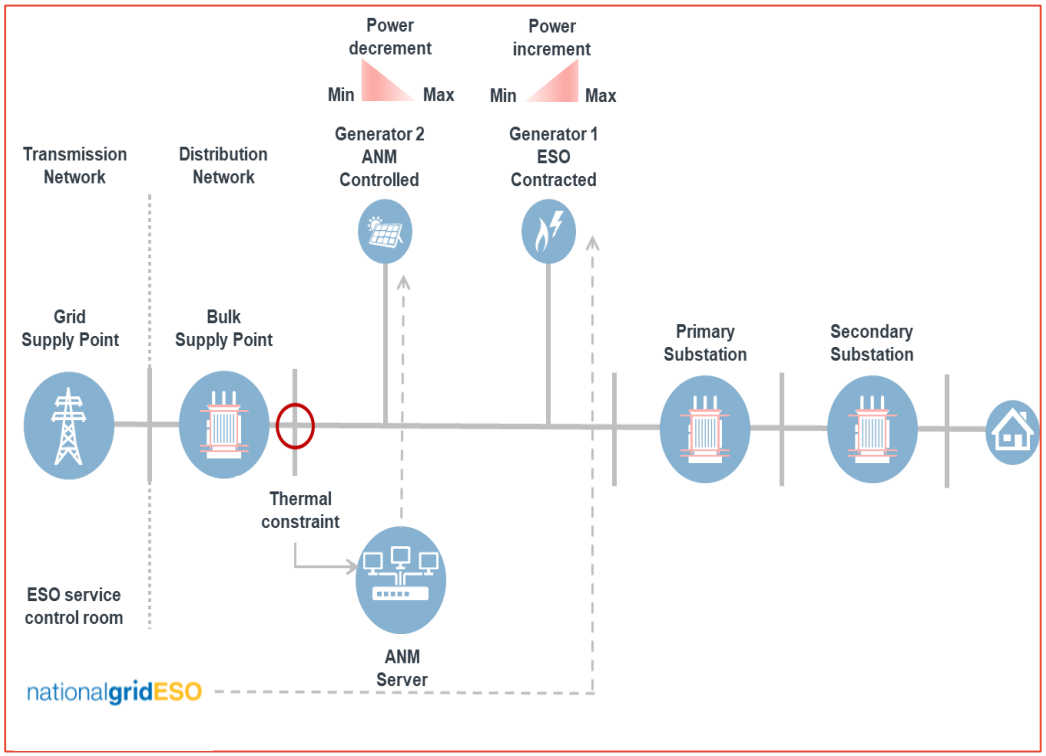
Test cases and solutions

Summary of test cases

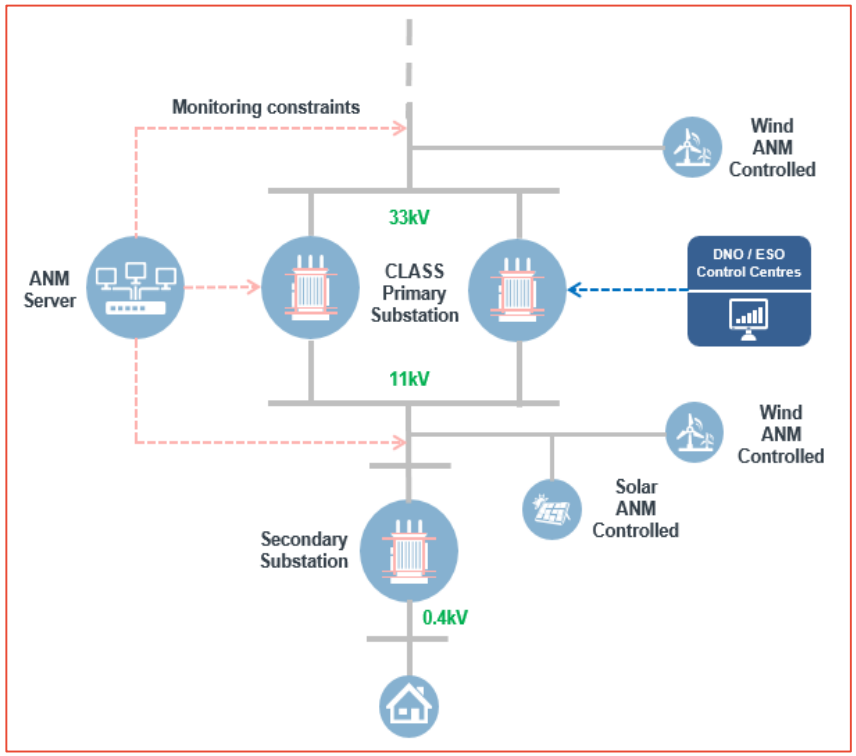
Test Case	Type of Test Case	Description
1A	ANM system counteracts BS provided by DER or transmission connected resources	Incrementing service action from a non-curtailable generator in an ANM area is counteracted by an ANM generator
1B		Decrementing service action from a non-curtailable generator in an ANM area is counteracted by an ANM generator
1C		Service action from a non-curtailable generator in a GEMS area is counteracted by a GEMS generator
2A	ANM system counteracts BS provided by DNO using CLASS system	Demand reduction through a lowering of tap position (through CLASS) is counteracted by downstream ANM scheme
2B		Demand boost through a raising of tap position (through CLASS) is counteracted by downstream ANM scheme
2C		Reactive power absorption through tap stagger (through CLASS) is counteracted by downstream ANM scheme
2D		Demand reduction through disconnection of one transformer is counteracted by downstream ANM scheme
3A	Non-delivery or non-participation by DER in BS due to ANM risks	ANM generator curtailed and defaults on BS
3B		ANM generator unable to access BS markets

- Test cases detailed in full in WS1/2 report: https://www.westernpower.co.uk/downloads-view/206443

Test case examples



Case 1: ANM system counteracts BS provided by DER



Case 2: ANM system counteracts BS using CLASS system

- Test cases detailed in full in WS1/2 report: https://www.westernpower.co.uk/downloads-view/206443

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Proposed solutions

Proposed solutions fall into four categories:

"W" solutions

- Reconfiguration of ANM schemes, for example to hold headroom preventing a Balancing Service being counteracted.

"X" solutions

- Improved information exchange between DNOs and generators, allowing generators to factor in the risk of curtailment to Balancing Services participation.

"Y" solutions

- Changes to Balancing Services procurement, allowing NG ESO to factor in the risk of curtailment when procuring Balancing Services.

"Z" solutions

- Coordinating CLASS and ANM systems to avoid counteraction.

- Full list of solutions in WS3 report: https://www.westernpower.co.uk/downloads-view/206446

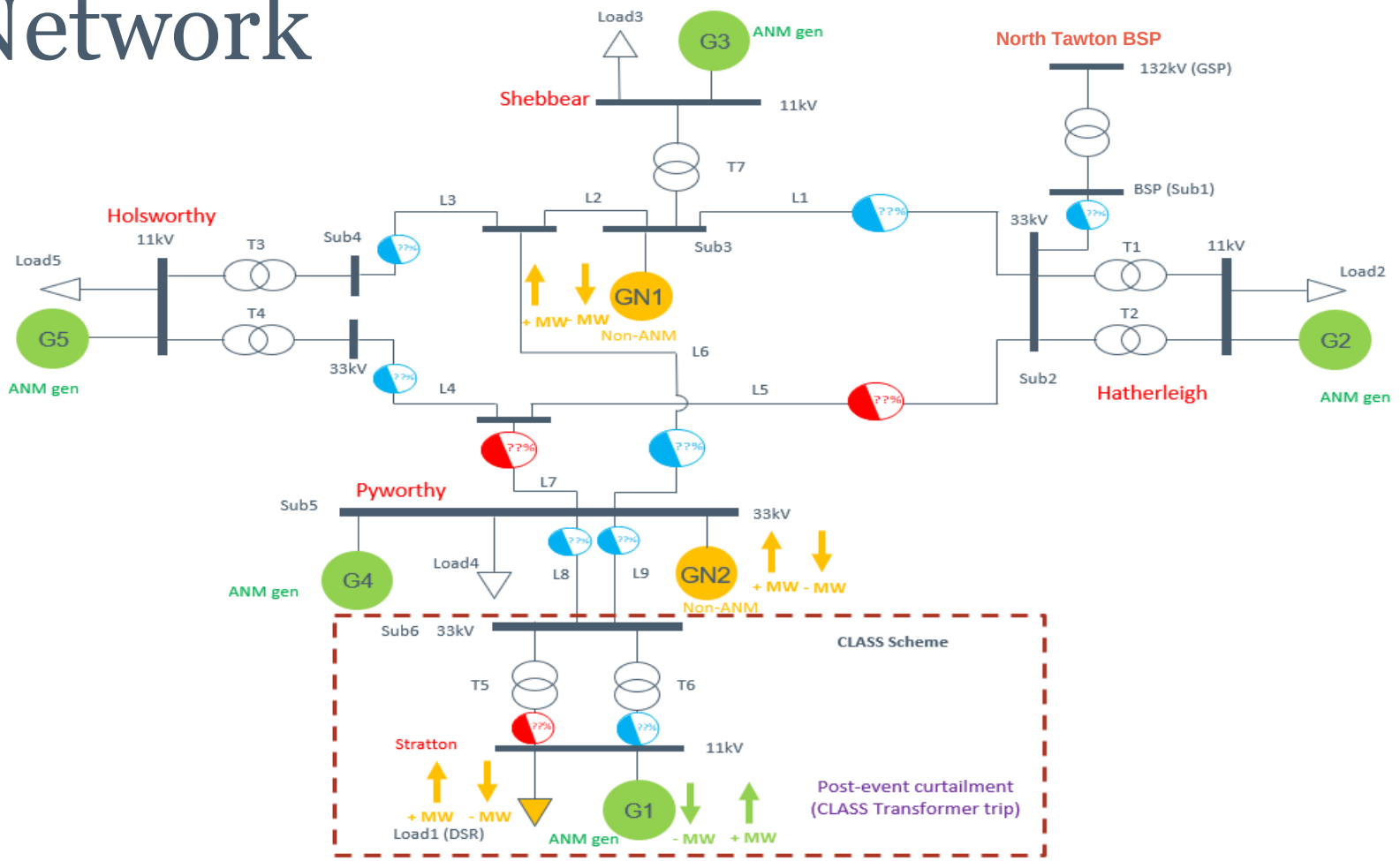
Shortlisting of solutions

Rank	Solution type	Impact Criteria					Total Score
		TRL	Regulatory Readiness	Commercial Readiness	Complexity	Impact of levels of curtailment	
1	Z1: CLASS ANM coordination	2	2	1	2	2	9 ✓
2	Z2: CLASS visibility of ANM	3	3	1	4	1	12 ✓
3	W1 Parallel decrementing ESO-ANM interface	3	3	2	3	2	13 ✓
4	X1: Improved Comms with generators	3	3	3	4	1	14 ✓
5	W2: Preparatory ESO-ANM interface	3	3	3	3	4	16 ✗
6	Y1: Risk-based BS	3	5	3	4	1	16 ✓
7	W3: Bring forward ANM curtailment	4	4	3	4	4	19 ✗

- The technical assessment focused on solution types Z and W1.

- Shortlisting in full in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

Technical assessment - Test Network



- Technical assessment in full in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

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Technical assessment – W1 and Z

W1

- Decrementing service by non-curtailable generators located at different locations.
- Different configurations of the selected test network:
  - All feeders are in services
  - Feeder L1 is out of service
  - Feeder L6 is out of service
- Changing the test network operating condition and network constraints by the addition of second 132kV grid connection

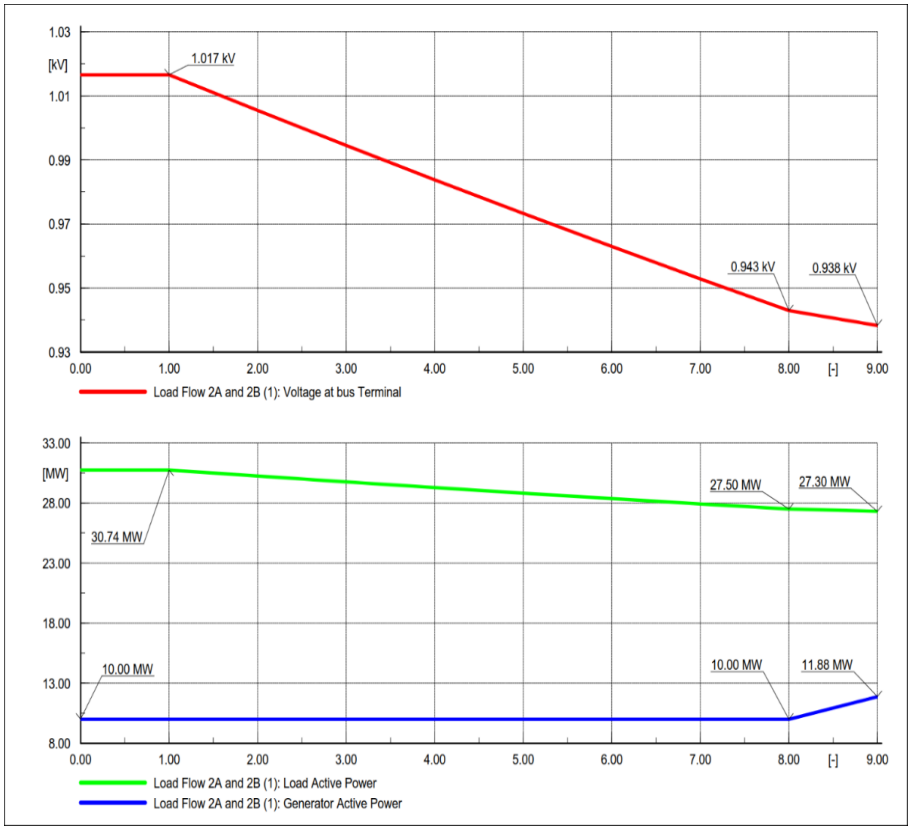
Z

- Assessing CLASS and ANM operating independently in different voltage bands by means of tap changer alteration or transformer trip

- Technical assessment in full in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

Simulation results - Z2 tap changer change

- Tap altered from -4 to +4
- Voltage becomes < 0.94pu
- ANM increases output to increase voltage
- In this case the ANM generator size would need increased to bring the voltage back to 0.94pu
- Once 0.94p.u. voltage is achieved CLASS would again take prominence



- Technical assessment in full in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

Conclusions

- Establishing a new communication route between NG ESO control room and ANM schemes can mitigate the conflict between ANM and BS delivery by DERs (e.g. ANM to hold headroom)
- W1 solution overcomes counteraction between BS operation and ANM actions
- Using different voltage bands to operate CLASS and ANM (e.g. solution Z2) can address the conflict between CLASS services and ANM

- Technical assessment in full in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

Commercial assessment of solutions

Assessment of benefits

- Two types of benefit assessed:

Reduced counteraction

- NG ESO does not have to procure additional volumes because of counteraction

Increased liquidity

- ANM generators can participate in Balancing Services, bringing costs down

- Three balancing services considered:

Balancing Mechanism (BM)

- Most used Balancing Service
- Most prone to counteraction risk

Firm Frequency Response (FFR)

- Fast response with short delivery
- Only static variants considered

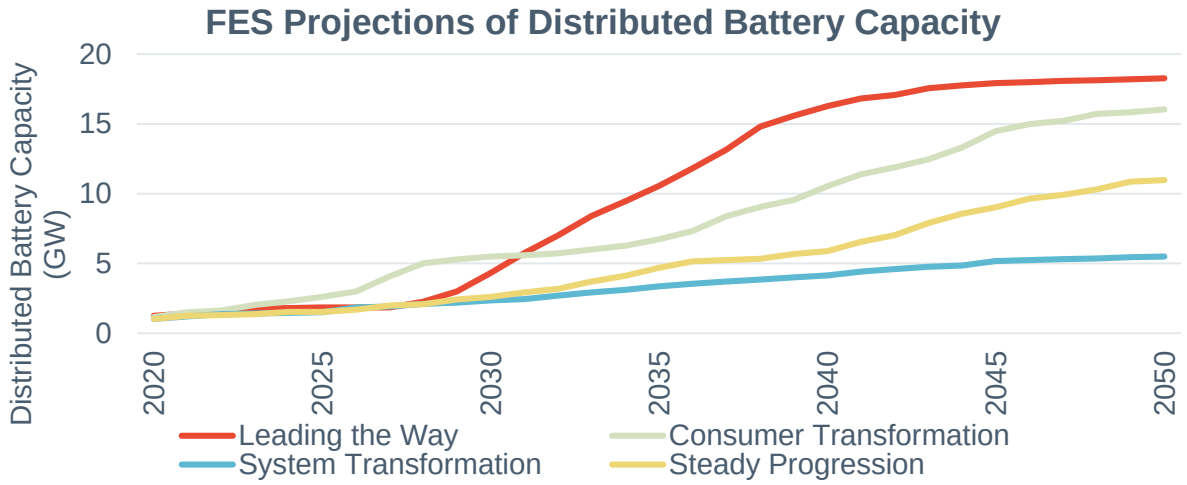
Short-Term Operating Reserve (STOR)

- Contrast to FFR – relatively slow response and longer delivery

- Full assessment in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

Qualitative benefits (1)

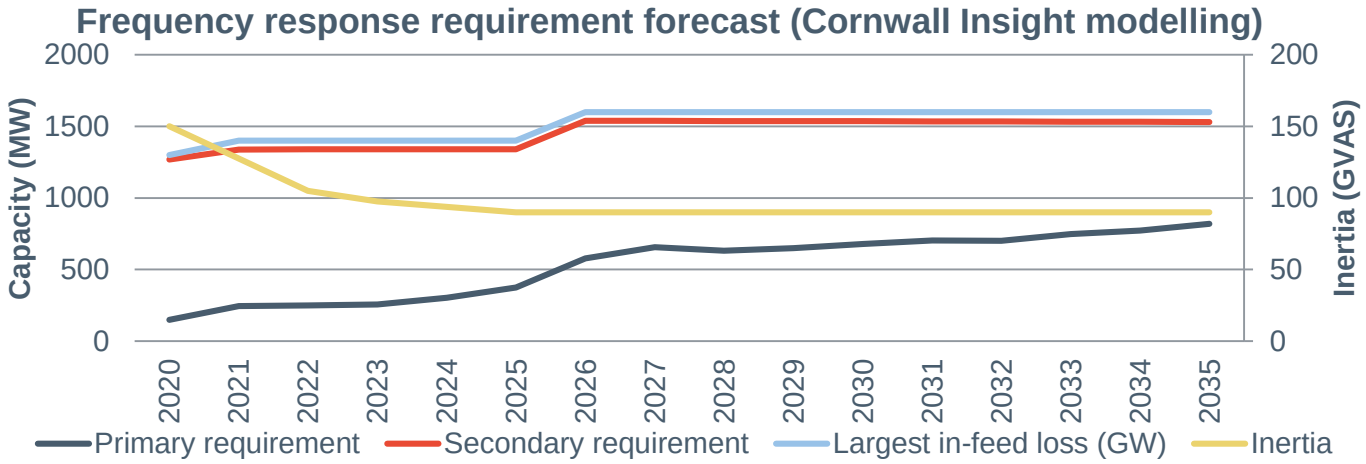
- DNOs have plans to increase ANM roll-out, and more generation connected at distribution level
  - More generation capacity will be behind ANM-managed constraints, and therefore subject to curtailment
  - Particularly pertinent for battery storage technology



- Full assessment in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

Qualitative benefits (2)

- Wider roll-out of CLASS, and increased service provision
  - Currently only trialled by ENWL
  - Limited FFR service provided by CLASS in 2019 and 2020
- Changing nature of Balancing Services and likely increased requirement for services from distributed resources



- Full assessment in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

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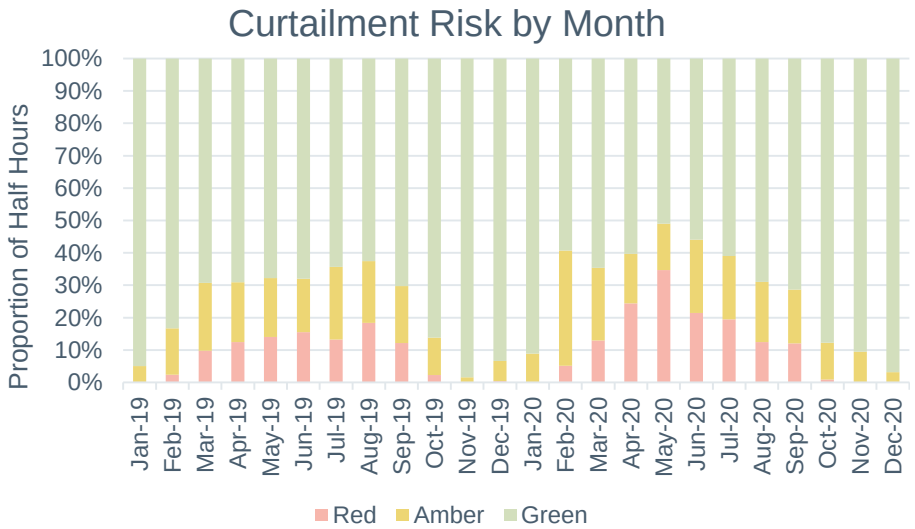
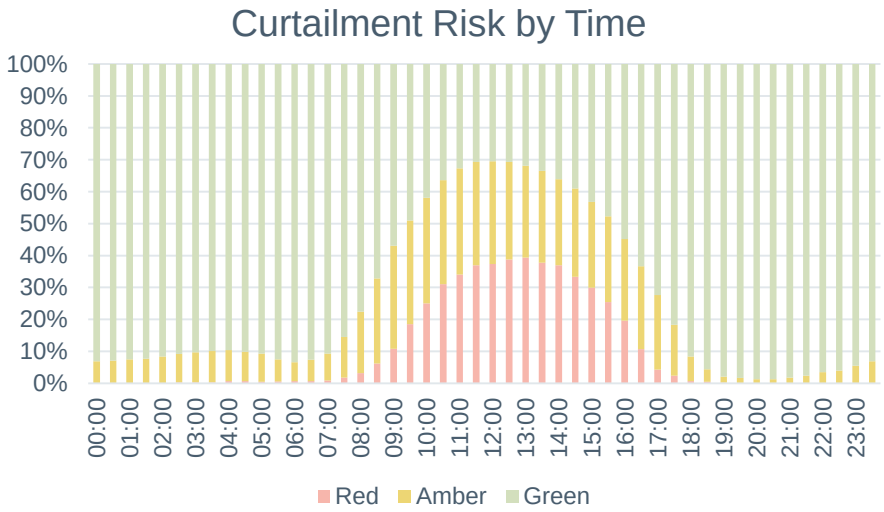
Curtailment assumptions

- Notional assumptions made about future ANM curtailment
  - Current information suggest ANM curtails ~1% of time
  - Likely to increase over time with lower demand and increased embedded renewables on system
- Time periods categorised into RAG for curtailment risk based on proportion of demand met by embedded renewables





- Full assessment in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

Summary of assessment

Annual benefits (averaged over 2019 and 2020)

Solution	Total annual benefit (£m)	BM benefit (£m)		STOR benefit (£m)	FFR benefit (£m)
		Avoided counteraction	Increased liquidity	Avoided counteraction	Avoided counteraction
W1 – parallel instructions	**37.6**	14.6	23.0	-	-
X1 – curtailment forecasting	**94.2**	34.5	53.3	5.2	1.4
Y1 – risk-based procurement	**120.6**	49.7	59.8	8.9	2.2

- Higher benefits come from solutions that appear most complex
- CLASS solutions – benefits small due to limited data – not progressed
- Costs of each solution primarily on systems and communications infrastructure

- Full conclusions in WS4 report: https://www.westernpower.co.uk/downloads-view-reciteme/302791

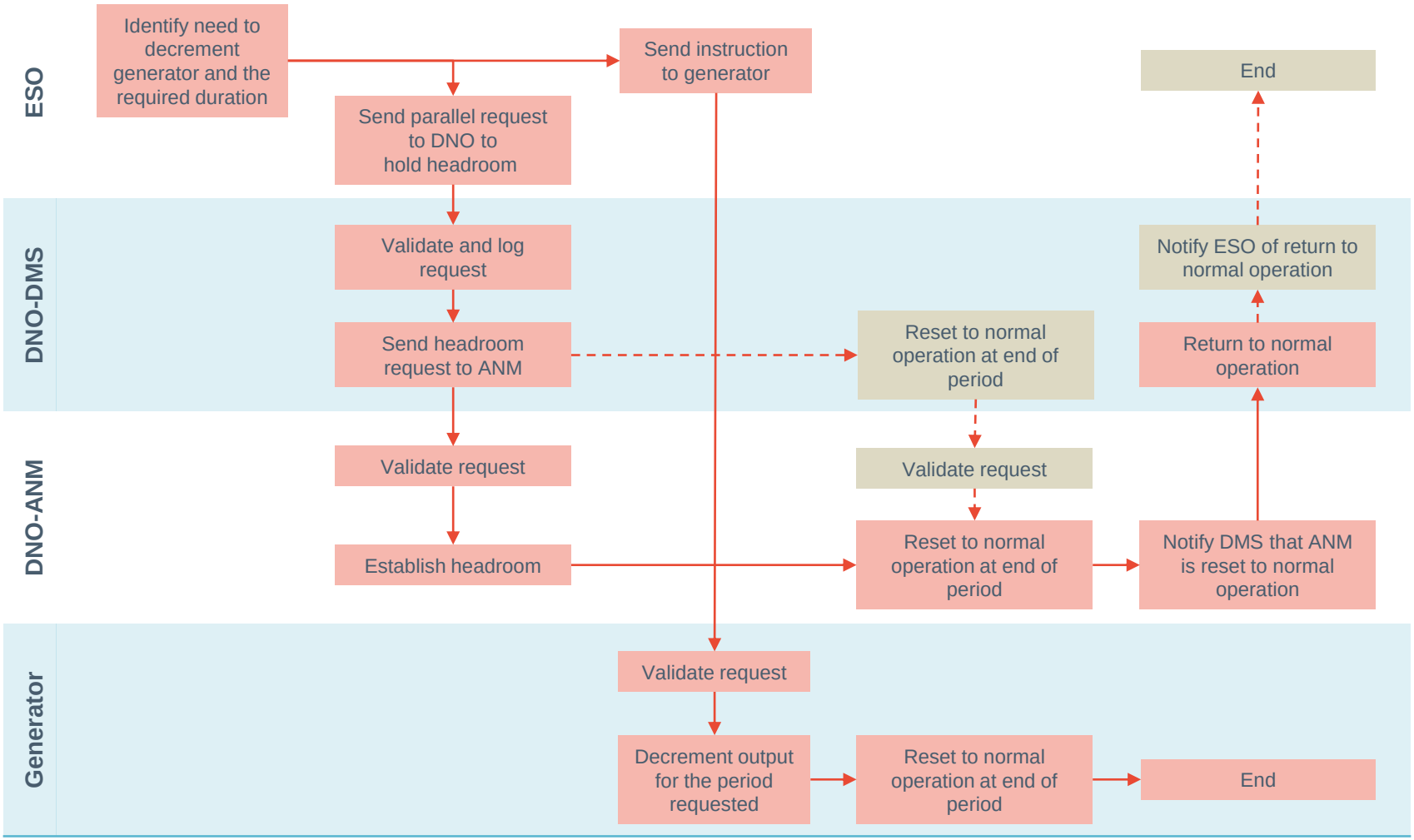
Implementing solutions

We developed a framework for identifying barriers to implementation

Technological	• How mature is the technology that needs to be implemented as part of the solution? • Are there any conflicts with existing technology that will need to be resolved?
Regulatory	• How does the solution align to relevant regulation (Network licences, Grid Code and Balancing Settlement code)? • If regulatory change is required, what is the route for progressing this? Would it require a modification, or wider consultation?
Commercial	• How does the solution interact with existing commercial arrangements for the procurement of Balancing Services? • Does the solution require any adjustments to ANM connection agreements?
Financial	• What investment is required to deliver the solution? Are there financial impacts for other parties?
Organisational	• What impact does the solution have on the existing roles of organisations involved in Balancing Services / ANM? • Will the solution create new responsibilities for any of these organisations? • If significant change is required, are the relevant organisations in a position to respond to this?
Process related	• How complex will the changes be to existing processes? • What groups of stakeholders will be impacted by these changes? • Are there interactions with processes outside of ANM / Balancing Services to consider?

- Full detail in WS5 report: https://www.westernpower.co.uk/downloads-view-reciteme/326608

Solution X1: Potential roles



- Full detail in WS5 report: https://www.westernpower.co.uk/downloads-view-reciteme/326608

Solution W1: Parallel Decrementing Instruction to DER and ANM

Action identified	Complexity	Dependencies with other actions	Short Term (1-2yrs)	Medium Term (2-5yrs)	Long Term (5yrs+)
Technological					
Instructions to DNOs	Low	Links to form of comms link			
Instructions from NG ESO	Low	Links to form of comms link			
Communication links	Medium	2029 deadline in ENA DSO roadmap			
Instructions to ANM schemes	Medium				
Regulatory					
Grid Code amendments (1)	Medium	Procedure dependent on comms link			
Other regulatory amendments	Medium	Changes from ENA's Open Networks			
Commercial					
Connection agreement changes	Low				
Curtailment information changes	Medium				
Organisational					
Additional instruction capability	Low				
Hold head room instructions	Medium				
Process					
Warning of decrementing instruction	Medium	Dependency on the procedure agreed within Grid Code amendments			
Standardisation of instruction process	Medium	DNO work to understand instruction requirements for different ANM schemes			

- Full detail in WS5 report: https://www.westernpower.co.uk/downloads-view-reciteme/326608

Solution X1: Improved communications with Generators

Action identified	Complexity	Dependencies with other actions	Short Term (1-2yrs)	Medium Term (2-5yrs)	Long Term (5yrs+)
Technological					
Communication links	Medium				
Curtailment forecasting	High	Technological developments are also dependent on actions required to develop resource capability			
Regulatory					
Distribution Code amendments	Medium	Scope of amendment should align to the forecasting capabilities developed by DNOs			
Generator Licence / BSC amendments	Medium				
Commercial					
Connection agreement changes	Low	Both changes must be consistent with the ultimate forecasting capabilities developed by DNOs			
Curtailment information changes	High				
Organisational					
Forecasting capability	High	Links to technological developments			
Process					
Forecasting process	Medium	Process will be informed by the format of forecast information			
Standardisation of information sharing process	Medium	Likely to be an enabling action to inform DNO work to develop capabilities			

- Full detail in WS5 report: https://www.westernpower.co.uk/downloads-view-reciteme/326608

Solution Y1: Risk-based Balancing Services Valuation

Action identified	Complexity	Dependencies with other actions	Short Term (1-2yrs)	Medium Term (2-5yrs)	Long Term (5yrs+)
Technological					
Communication links	Medium	Deadline of 2029 in ENA DSO roadmap			
Curtailment forecasting	High				
Regulatory					
Risk-based framework	High				
BSC amendments	Medium	To align with the risk-based framework			
Distribution Code amendments	Low	To align with forecasting capabilities developed by DNOs			
Commercial					
Risk-based framework	High				
Non-delivery assessment	Medium				
Organisational					
Risk-based framework deployment	High	Requires conclusion of framework			
Developing forecasting capability	High				
Process					
Forecasting process	Medium	To align with forecasting capabilities developed by DNOs			
Standardisation of information sharing process	Medium	To align with relevant BSC amendments			
Non-delivery assessment process					

- Full detail in WS5 report: https://www.westernpower.co.uk/downloads-view-reciteme/326608

Remarks from WPD and NG ESO

WPD – forecasting update

Solutions X1 and Y1 require forecasting ANM actions. This will rely on forecasts for many points within an ANM controlled area and inaccuracies can compound. EFFS forecasting highlights some of the hurdles to overcome.

Electricity Flexibility Forecasting System

Summary of Initial Forecast Accuracy

WPD INNOVATION

Equipment Type	Channel Type	Mean Absolute Percentage Error*	Mean Absolute Error*
Primary Substation	MVAR	11.63%	0.22
	MW	10.24%	0.80
Solar Farm	MVAR	99.29%	0.12
	MW	75.56%	0.37
Storage Generator	MVAR	200%	0.34
	MW	200%	2.54

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*Closer to zero the better the prediction

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- Weather driven outputs will reflect weather forecast inaccuracy
- Operation of STOR very hard to predict
- Standard metrics may not be appropriate
- Collaboration is needed

Q&A

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Further information

- All project documents available here:

  https://www.westernpower.co.uk/innovation/projects/optimal-coordination-of-active-network-management-schemes-and-balancing-services-market

- Further information on EFFS here:

  https://www.westernpower.co.uk/innovation/projects/effs

- Further information on Open Networks:

  https://www.energynetworks.org/creating-tomorrows-networks/open-networks