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- The webinar will start shortly
 - Please make sure your microphone is muted and your camera is turned off
 - Please submit any questions by going to <http://sli.do> and using the code at the bottom of each slide
 - **Please note the webinar will be recorded**

Future of Reactive Power

Friday 11th December 10:00 – 11:00

Sli.do code: #P448

Housekeeping

We are using Sli.do for Q&A – please navigate to www.slido.com and use the event code #P448 at the bottom of each slide.

There is a survey to fill in on Sli.do too – it will be open throughout the webinar.

Purpose

- Introduce the approach used to review and develop Future of Reactive Power
- Explain the work done so far about problem review and current output from existing work
- Engage and capture feedback with industry to work through the journey together
- Outline the next plan

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Agenda

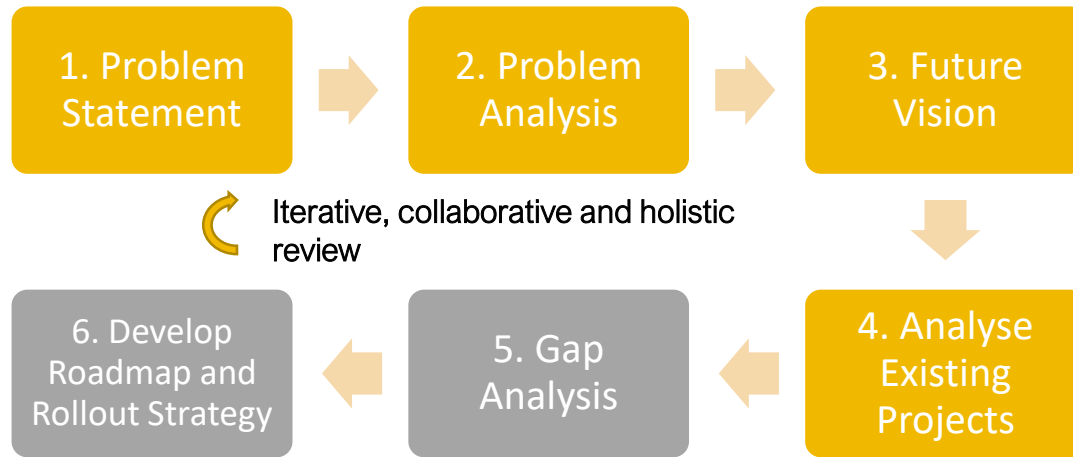
	Presenter	Team
Approach of developing future of reactive power	Yuting Dai	Market Change Delivery
Problem review – Operability	Jarnail Bansal	Electricity Network Control Centre
Problem review – Cost	Djaved Rostom	Network Operability
Problem review – Future Ambitions	Eleanor Horn	Market Development
Key themes on the initial feedback	Eleanor Horn	Market Development
Vision and next step	Yuting Dai	Market Change Delivery
Question and Answer Session	All	
Summary	Yuting Dai	Market Change Delivery

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Approach of developing the 'Future of Reactive Power' work

Key Approach

The Future of Reactive work takes a holistic approach to reviewing ESO's Reactive Power services.

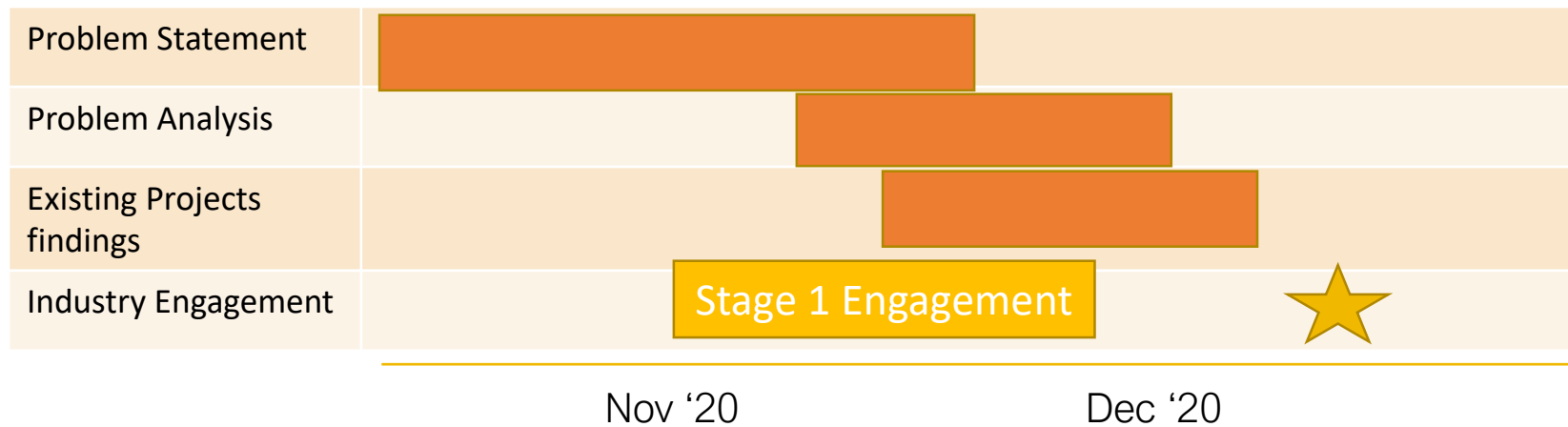


We are sharing the work done so far for step 1 - 4, the output of this work is contained within this webinar.

Recent activities

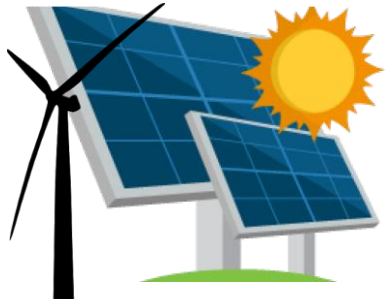
- Mersey pathfinder tender (Completed)
- Pennine pathfinder tender (Imminent)
- Power Potential (Ongoing)
- South Wales reactive tender (Completed)
- DNO boundary transfers (Ongoing)
- MBSS reporting changes (Completed)

Timeline of the Project so far



Problem 1: System Operability

Controlling voltage on the NETS (both “Dynamic” and “Static”) is becoming more challenging; there is an increasing risk to the ESO of breaching SQSS voltage compliance limits, now and in the future.



More Distributed Energy = More Issues with High Volts and Access to Fewer Traditional Providers

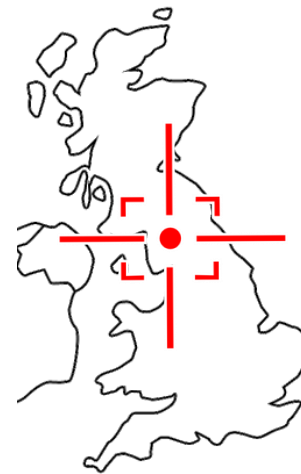
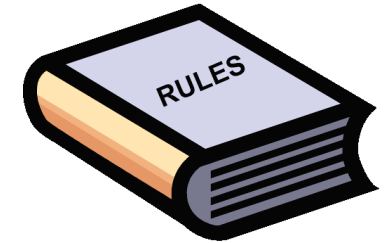


Increasing reliance on TO assets

TO owned Reactors and Capacitors help ESO manage volts

Uncertain MVar from Dx Network

There is no framework to coordinate voltage control between ESO and DSO



Difficult to Model/Forecast MVar Demand

Requirements change Depending on Local Conditions



Buying MW to Access MVar

Can cause other Operability Issues if Active Power is not needed.

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P1 → Observations from existing projects

Power Potential

- World first project to explore reactive power provision from DER and provide access to more diverse sources of dynamic voltage support.
- The project's commercial framework arrangements are back to back (NGESO-UKPN-DER) which is only one route to market.
- Designed, built, and currently trialling the use of a Distributed Energy Management System (DERMS) hosted and enabled by UKPN to allow ESO to instruct dynamic voltage service from DER.
- Test the technical capability of DER to deliver dynamic voltage support and assess the impact at the transmission level.

Voltage Pathfinders

- Proved that new providers and commercial solutions can provide long-term static voltage support and provide an alternative to ORPS in that region.
- The project has contracted with "OMW solutions" which offer an alternative to the requirement to buy MW for MVar problem.
- Mersey pathfinder project have worked with the host DNO (SP Manweb) to facilitate a review of the feasibility of technical solutions offered and discovered the power factor restrictions on the distribution network limit some embedded providers in providing reactive power.
- The requirement analysis methodology has been reasonably well developed, however, There are challenges in specifying/communicating the volume and location of the system need at sufficient granularity as there are many complexities including the trigger (pre/post fault), effectiveness and interactions between solutions.
- For the upcoming Pennines pathfinder tender the team are working on an approach to manage the complexity and expect to provide clearer information regarding the requirement and potential target sites.

Other activities

- **PEF project** using machine learning to forecast short term MVar demand. Forecast should be more accurate and achieve greater granularity down to individual GSP nodes.
- ESO liaised with TOs about reactive assets outage planning and availability need
- **Network Boundary Transfer** project to define D → T reactive limits and identified some challenges for a generic solution

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Problem 2: Voltage Costs

Spend on voltage services has increased over the past few years and there is a risk it continues to increase in the future.



Buying extra MW to Access MVar

The unnecessary MW are costly and add no value.

Separate Procurement

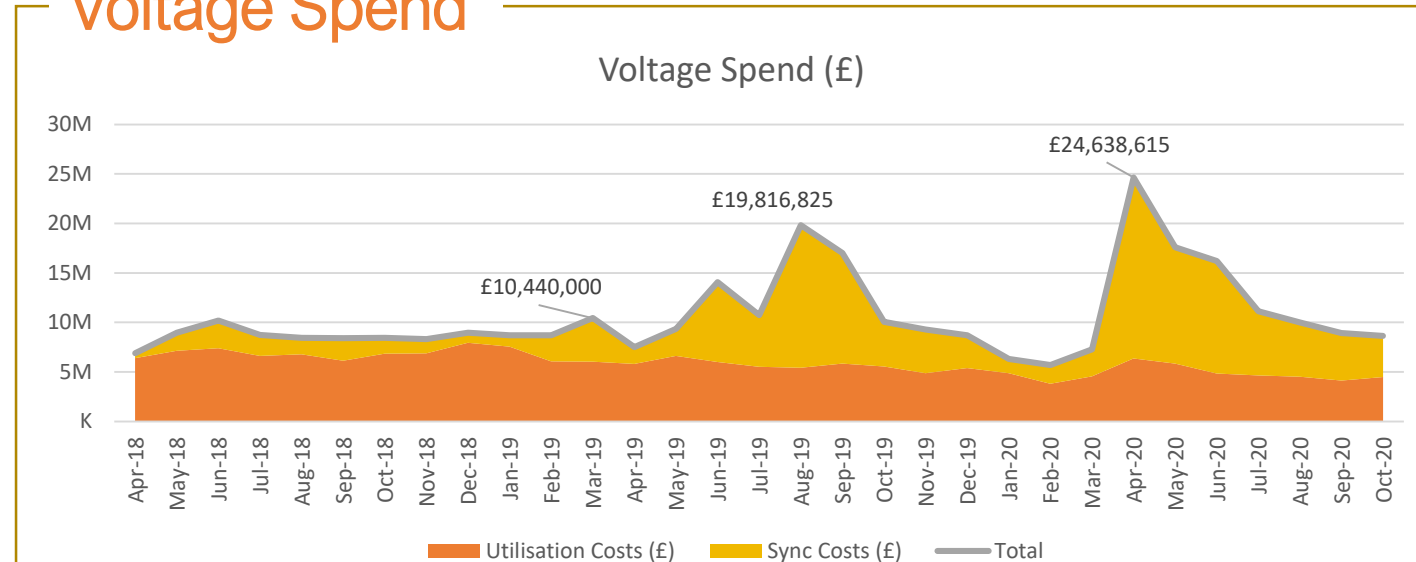
Meeting dynamic/static and voltage/stability needs separately may not be most efficient.



Lack of Competition

Competition to provide voltage support services may reduce costs and stimulate innovation.

Voltage Spend



	Average Monthly Cost	% change YoY
2018/19	£ 8,759,167	Base
2019/20	£ 10,480,289	20%
2020/21 (so far Apr - Oct)	£ 13,870,981	32%

P2 → Observations from existing projects

Power Potential

- Build mechanisms to enable DER to participate more easily in markets for transmission voltage needs and prove effectiveness.
- The project is working with various technology types such as wind, solar and battery. The inclusion of a solar provider is the first time reactive support is being provided by this technology type.

Voltage Pathfinders

- Proved that commercial voltage solutions can compete with TO build voltage solutions and provide a cost-effective option.
- Tendered for a reactive power service to include distributed energy resources (DER), and procured these services through 'transparent, non-discriminatory and market-based procedures' and allowed 'the participation of all qualified electricity undertaking and market participants'.
- Voltage pathfinder are only procuring static reactive power absorption, power potential is procuring dynamic reactive power from DER, while stability pathfinder is procuring stability services include dynamic reactive power, there is opportunity to explore how reactive and stability requirements can be coordinated and procured in the future.
- Challenges to be overcome in moving towards a level playing field between TO solutions and merchant solutions, decision from Ofgem on Transmission Demand Residual (CMP334) a good step forward.

Problem 3: Achieve ESO Ambition

The ESO has ambitions to deliver Competition Everywhere, Zero-Carbon System Operation and Whole Systems Outcomes by 2025, we need to find a better way for reactive power strategy to align with those ambitions



Competition Everywhere

ESO has ambitions to procure 10% of voltage services through competitive means by 2023*

Existing Issues for Competition

- ORPS pricing mechanism offers no opportunity for competition between providers
- Existing competitive tenders or pathfinders have been driven by compliance requirements rather than with the explicit aim of introducing competitive procurement
- More clarity is required on how to facilitate DER, offshore resource, HVDC to add values into reactive power provision

Zero-Carbon System Operation

By the end of 2025 the ESO will have the capability to operate the system with only zero-carbon generators. Reactive Power procurement strategies need to align with this goal.



Whole Systems Outcomes

ESO needs to work with the emerging DSOs to ensure that procurement for voltage services is aligned and coordinated. This needs to be a key consideration of future work in this area.



P3 → Observations from existing projects

Power Potential

- DERMS interfaces with ESO PAS and UKPN's PowerON system to enable real-time instruction of DER.
- Power Potential will investigate the effectiveness of DER as seen from the Transmission System.
- The Power Potential trial is operating to the same level of data transparency that is available for transmission connected assets. During the Wave 2 (market trials) the project will aim to share various network operating scenarios that will be simulated during the market trials.

Voltage Pathfinders

- Learnings from the Mersey tender have prompted ESO to explore how more information from network owners can be provided to participants.
- Long term Mersey Pathfinder project has created some level of competition in the specific region but is not expected to stimulate the market or increase market liquidity on an ongoing basis.
- Mersey pathfinder project have worked with the host DNO (SP Manweb) to facilitate a review of the feasibility of technical solutions offered and discovered the power factor restrictions on the distribution network may limit some embedded providers in providing reactive power

Other Activities

- CMP305 modification to remove ERPS tender requirement from the CUSC.
- Offshore effectiveness: Offshore Generators and OFTOs have mandatory reactive/voltage obligations. These obligations are not bespoke to the location of these sites at the periphery of the grid. Some work has been undertaken to understand the effectiveness of Offshore, work still to be completed or provide recommendations.
- Network Boundary Transfer project is set to define D -> T reactive limits and have identified some challenges for a generic solution.

Key Themes from feedback received so far



Transparency of Requirements

Feedback from industry has been that to drive innovation and investment where it's needed the ESO needs to be open and transparent about its requirements, clearly signalling where reactive capability would be valued. This will require a high level of granularity.



Payment Structures that Recognise Commercial Drivers

Our contract and payment structures need to account for commercial drivers. Industry consultation can support the design of practical payment structures that encourage maximum participation in markets.

Provide Strong Value Signals

To make investment decisions information about where to locate and what capability to invest in is crucial. By correctly valuing reactive power capability the ESO can drive consumer value. This also extends to the mandated requirement.



Support Participation from Non-Traditional Providers

There are a number of technologies such as HVDC or Solar PV which have reactive capability but are still emerging into the mainstream.



Level Playing Field

Markets should be structured so incumbents and entrants have equal opportunities.



Vision of procuring reactive power service

Our vision is to be able to tailor our requirements area by area, procure from the most cost-effective providers, and broadcast the broad value of reactive solutions in each area:

- Our procurement decision will be **transparent** and our **methodology** and **needs** will be clear to the market ahead of time
- The design of our products, the way we procure, and the contractual arrangements will **increase competition** in provision of services to the ESO
- Our products will be designed to balance both operational requirements and the technical ability of provider assets while maintaining **system security**

Next Plan

- Review and update problem analysis from webinar feedback - Jan 21
- Identify the key gaps requiring further work – Feb 21
- Develop plan to explore solutions – Mar 21
- Industry webinar to update the output and next plan – Mar 21



Q&A

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Audience Q&A Session

 Start presenting to display the audience questions on this slide.

Summary

Thank you for your attendance and feedback

- Slido event is open until 18th Dec to receive any further questions and feedback
- FAQ documents will be published after webinar and updated in the future of balancing services webpage

<https://www.nationalgrideso.com/research-publications/future-balancing-services>

- We will share next engagement activities once confirmed to provide you an update on analysis work
- We would like to hear your thoughts, suggestion or feedback, please contact us via your account manager, or via our Future of Balancing Services email address: box.futureofbalancingservices@nationalgrideso.com