ESO Technology Advisory Council

TAC-5

Date:	03/12/2021	**Location:**	Virtual
Start:	09:00	**End:**	12:30

The feedback captured during the meeting on the Axis collaboration tool can be found in the accompanying spreadsheet. This document summarises the feedback received verbally and via the Chat function.

All material from the meeting can be found on the ESO Technology Advisory Council website: https://www.nationalgrideso.com/who-we-are/stakeholder-groups/technology-advisory-council

Participants

Attendee	Organisation
Vernon Everitt (Chair)	Transport for London
Graham Campbell	Scottish Power Energy Networks
Chris Dent	University of Edinburgh
Andy Hadland	Arenko
Naomi Baker	Energy UK
Alastair Martin	Flexitricity
Kate Garth	RWE Renewables
Alvaro Sanchez Mirales	STEMY Energy
Simon Pearson	Energy Systems Catapult
Melissa Stark	Accenture
David Sykes	Octopus Energy
Alex Waslin	BP
Fred Drewitt	Limejump
James Houlton	Amazon Web Services
Teodora Kaneva	TechUK
Chris Kimmett	Reactive Technologies
Peter Stanley	Elexon
Claudia Centazzo	Independent
Judith Ward	Sustainability First

Sonia Lalli (Facilitator)	Accenture
David Bowman	ESO
Norma Dove-Edwin	ESO

For specific agenda items

Attendee	Organisation
Dan Delgado	ESO
Amy Brooks	ESO
Stephen Bird	Capgemini
Jay Ramachandran	ESO
Tim Pinto	ESO
James Daniels	ESO
Subramanian Pichaivalli	ESO
Carolina Tortora	ESO

Apologies

Attendee	Organisation
Anastasia Vaia	BP
Jo-Jo Hubbard	Electron
Randolph Brazier	ESO
Ulrika Wising	Shell Renewables and Energy Solutions

Agenda

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1.	Welcome and introductions
2.	Minutes of last meeting and matters arising
3.	Feedback from last meeting
4.	Zero-carbon operability / Enhanced Frequency Control
5.	The GB Virtual Energy System
6.	RIIO-2 BP2
7.	Subgroups update
8.	Next meeting and calendar
9.	AOB

Discussion and details

#	Topics discussed
1.	**Welcome and introductions** • The chair welcomed everyone to the meeting. • Emma Pinchbeck has stepped down as the Energy UK representative. Naomi Baker is the new member. • Alex Waslin is standing in for Anastasia Vaia as the BP representative for this meeting only.
2.	**Minutes of last meeting and matters arising** • The chair noted that the minutes of the last meeting were agreed by circulation had been published on the ESO website. • The feedback from the meeting has also been published on the ESO website. • Feedback and suggested topics for future discussion, as provided in the survey of members, were discussed. • The chair provided a brief overview of the key discussion points he had with the ESO Executive team in October.
3.	**Feedback from the last Meeting** • Dan Delgado and Steve Bird summarised how the feedback from the last meeting on the Digitalisation Strategy and Action Plan (DSAP) had been used. • The key themes are customer-focused delivery, implementing a digital ESO culture and implementing a product-based operating model. The feedback will be used to update the DSAP and in the long-term delivery.
4.	**Zero carbon operability / Enhanced frequency control** • Jay Ramachandran introduced the Enhanced Frequency Control (EFC) project. • The project drivers are GB system changes, including less synchronous generation, lower inertia and the impact of rate of change of frequency (RoCoF) and regional variations in system frequency. • The EFC project follows on from the Enhanced Frequency Control Capability (EFCC) project that was funded through the Network Innovation Competition (NIC) opportunity. • The scope of the work and the phased implementation approach were outlined. • The proposed design architecture for Phase 1 was summarised. **The feedback captured on the Axis collaboration tool can be found in the accompanying spreadsheet. The notes here are a summary of the discussion during this section.** *Decision support* • Are there any decision support or algorithmic requirements that go beyond business as usual? There are analogies with the modern dispatch instructor project which aims to facilitate many small parties in the balancing mechanism (BM) by providing an economic advice tool that can handle lots of market participants. • There are many technology challenges, including communication links, phasor measurement unit (PMU) and phasor data concentrator (PDC) developments. The aim is not just to cover BM participants but also all embedded generators that are able to provide frequency response services. As part of Phase 1, we will be exploring how we need to interact with units with different characteristics, for example single vs aggregated units or transmission vs distribution connected units. *Communications*

- Look at how companies have rolled out Dynamic Containment (DC), because that has a similar specification in terms of monitoring local frequencies and responding quickly. The 0.5 second response time may be challenging to pull frequency data back to a central computer, run an algorithm to decide what to dispatch and send an instruction. Many providers will be using 3G or 4G networks, rather than fibre-optic connections, which may not provide the latency required.
- On the other hand, it could be argued that 0.5 seconds is a very long time in communication. For example, a 0.5 second lag on a video call would be a pain. Communication networks have solved a lot of similar issues.
  - We would like to test this in Phase 1 – seeing what and how much infrastructure is required to achieve the desired solutions within 0.5 seconds. The phased approach allows us to learn and refine as quickly as possible.
- Need to be careful not to oversimplify the communications challenge because there are several different proposed architecture variations, from central or regional control to a system which chooses how much response should be present in an area, like an arm/disarm capability. The area between these two needs to be explored to get a tractable communications proposition.
- There is a requirement for standards to be size appropriate - a battery in a field is unlikely to be connected to a fibre-optic network. So, the architecture needs to be right to allow the communications to be affordable for the technology being used. This might mean that different technologies are used in different ways. This is analogous to settlements where electricity bills are calculated using meters that are size appropriate.

Interactions with DC and Pathfinder projects

- What benefit does EFC bring over and above DC and the Pathfinder projects? How are they different?
  - The main aim of EFC is to coordinate response different service providers and technologies. DC is generally dominated by a single technology type (batteries). With EFC, different technologies could be coordinated in different time periods to reduce the frequency deviation.
  - The main difference between DC and EFC is that DC responds to frequency and EFC responds to the rate of change of frequency (RoCoF). So, they are targeting subtly different issues and there is a different mathematical calculation needed. The inertia pathfinders are looking at different ways of responding to the same issue of decreasing inertia. Having many viable solutions will help find the lowest cost solution.
  - The EFC project is liaising with the DC project, as well as looking at how we interact with new services like Dynamic Moderation (DM) and Dynamic Regulation (DR).

Market rules

- This is an opportunity to test not only the technology but also the market rules needed to support this. For example, a wind provider might technically be able to meet the requirements, but a battery might be better. However, a provider might then lose their renewable obligation certificate (ROC). Putting together different combinations of technologies to fulfil a requirement may mean market rules need to change.
  - The EFCC project looked at having combinations of solar, wind and batteries providing solutions over different time periods, so we will look for any learning there.

Design principles

- It would be good to see the design principles. It is important not to make architectural decisions without clear requirements – what are we trying to solve and for what? The architecture and other frameworks would be different if it was for millions of electric vehicles or transmission connected wind. It might need an API for the former and a local controller for the latter.
  - The aim is not only to correct frequency deviations but also allow all parties to participate in frequency response.
  - The proposed initial architecture is taken from the output of the EFCC project and is a starting point. Work in early phases of the project is about understanding the behaviours of local and

regional controllers, investigating data requirements, and understanding communication issues, all with a view to updating the architecture.

- We are looking at different types of controller. At some point the local controller could itself be an API rather than a physical device. As part of Phase 0, we are also exploring a "gateway" that would allow all units to come in via the internet.

ESO-DSO coordination

- The future system is going to look very different to today. Currently, voltage control is mainly a DNO activity and frequency control an ESO one, but this could change in the future. What could a DSO's role be in enhanced frequency control?
- Coordination of activities between DSO and ESO is critical to this. What we need to be mindful of is the unintended consequences of actions being taken at a domestic level (EVs / heat pumps) that could create a local constraint. It is manageable when penetration is low but large-scale use of domestic resources could be problematic.
- A lot of work about linking transmission system operators like the ESO to distributed resources is not considering distribution constraints. There have been examples of constraints being experienced on the low voltage system (feeding homes and business) where actions are being taken in response to national issues.
- Frequency response can be provided by lots of different providers at all scales. However, to shift frequency to cause a problem, a lot of megawatts need change quickly, so the danger is likely to come from transmission assets. This could mean that frequency control should stay within the ESO's domain.
- Project CLASS (Customer Load Active System Services) – reducing customer voltage levels to manage demand – highlighted the danger of monopolistic tendencies. DNOs may need to have structural independence (like the ESO) before they coordinate response services. They must be facilitators and need to be neutral.
  - What the EFC project is trying to understand is whether embedded generations are going to participate and then, at a DNO level, how much they can increase or decrease their output and the impact it will have.
  - The engagement in Phase 0 includes all parties, including DNOs.

Relevant international comparators

- Are they relevant international lessons on EFC in a heavily renewable and/or distributed system? It is always helpful to look elsewhere. Denmark and northern Germany are wrestling with similar challenges to GB.
- Texas may be a comparator because it has a similar peak load and wind capacity.
- Is the ESO looking at the Irish market? They have a much higher penetration of non-synchronous generation and by 2030 there may be times of 95-100% non-synchronous generation.
  - Similar schemes have been tested in Iceland and South Australia. But we need to be mindful that their networks and the reasons for implementation are different. In South Australia it was more about improving frequency measurements.
  - We will explore the other suggested comparators provided here. The European Networks of Transmission System Operators for Electricity (ENTSOE) also have a research proposal for wide area frequency control.

5.

- Carolina Tortora (Head of Innovation) presented an overview of the GB Virtual Energy System (VES). This is the ESO's plan to create a digital twin of the GB energy network.
- The VES was launched in November 2021 during COP 26. On 1 December there was VES conference with 500 subscribers.
- The VES is a replica of the GB energy system. Its purpose is to run simulations to improve decision making by reducing guesswork and noise.
- Carolina highlighted the main challenges for the programme. They are:

- Coordination - given that this is a virtual replica of the physical system, everyone must be represented and interlink correctly.
- Data – ensuring the programmes have the right framework. All the components need to talk to each other properly. It must be universal, standardised, and future proof. The ESO is working internally and externally to start coordination on systems and standards.
- Benefits – this cannot become the ESO's (or anybody else's) vanity project. It needs to demonstrate value for the whole industry as early as possible. The benefits will come from the various components being joined together. Many benefits will be realised in the future, but we will look at where it can add value now. The first project is a dynamic dispatch optimiser tool which has started with Google X.
- Funding – this needs to be worked out. It will probably be a combination of different mechanism including innovation allowances and regulatory settlements. It will require coordination of funding mechanisms across all parties involved. An added challenge is that each funding mechanism comes with its own requirements.

Discussion

- Will the VES model the whole energy system or is it just focused on electricity?
  - The ESO is currently exploring funding through two proposals in the Strategic Innovation Fund (SIF). Both have support from National Grid Gas Transmission (which includes the gas system operator). The ESO has the support of its gas colleagues and it is also supporting their own digital twin proposals.
  - One of the SIF proposals is trying to set up an enduring digital twin. The SIF works by setting challenges every year that companies respond to. Given the digital twin should be an enduring programme, we are working with UK Research & Innovation, who oversee the SIF along with Ofgem, to see if there can be an enduring digital twin subsection to the SIF that everyone can respond to.
- How do the VES proposals align with the National Digital Twin and other analogous programmes?
  - The engagement strategy will focus on three workstreams spanning technology and business cases. One is looking at benefits that different use cases and tools could bring. Second, around governance, regulation, and process. Third on technology, data and security.
  - One of the key issues of workstream two will be working out minimum common standards across different platforms and tools.
- Alongside data interoperability, the operation and decision algorithms might look different across different applications (eg planning, policy, real-time operations)
- How do you plan to coordinate with research organisations? What kind of applied research will bring benefits to the industry? They may be areas of work that universities are best placed to do, for example funded research.
  - The ESO has already started engaging with academia and research institutions. The programme will be a combination of innovation, business-as-usual, and research and development.
  - The work needs to be future-proof, and many of the benefits will arise from solving future problems. But the VES needs to provide benefits now, especially as the funding mechanisms mean that consumers today are paying.
  - We see a large role for academia in workstreams one and three above.
- How do external organisations provide data to the ESO that it may not have? For example, demand side input data that could be increasingly important for the ESO to see. Sustainability First have data that may be of interest.
  - The ESO is open to receiving suggestions for data that others have and will discuss with interested parties.
- One of the challenges for digital twin projects is access to static data like network topologies and the location of assets. Is there a plan for working with DNOs and others to collect data and fill in the gaps?

- The understanding of network topologies is patchy, and it is not unique to GB.
- We are working on a project, led by the transmission owners, to map out the entire electricity grid by location.
- As the ESO is not an asset-based organisation, it is right that the projects are led by the asset-owning organisations with the ESO setting the standards and framing the questions that should be answered.

- There is a challenge associated with the ESO using the VES (or other models) to create forecasts and operating plans. Others use these as starting points for their own plans, which invalidates the ESO's original assumption, creating a loop. To avoid such loops, models should be run in the open.
- The ESO has added more information to forecasts over time. The more openness parties have of when and how things are considered by the ESO the more useful forecasts become.
- Feedback loops can be useful and minimise cost if people understand them.
  - There is a similar issue where errors and approximations can multiply. We will use machine learning tools to dampen the effects of reinforcement of error.
  - Open data is fundamental, but data privacy and cyber security must be considered. There may be levels of access restricting who can see what, but this will provide the opportunity for people to view and correct their own data.
  - The ESO wants the VES to have behavioural layer. The dynamic dispatch optimiser tool being developed with Google X is looking at this – for example, what happens if a particular party bids in a certain way, or if the ESO takes a certain action. This is a key step to creating a tool where the final goal is to minimise costs for the consumer.

6. RIIO-2 BP2

- Dan Delgado and Stephen Bird outlined the latest guidance from Ofgem on how the ESO should present its IT investments.
- This involves using the Technology Business Management (TBM) taxonomy. The ESO supports this approach but is not familiar with it because we currently use a central allocation cost model.
- TBM is an industry standard framework. It allows you to provide a cost structure, justification and showcase the benefits, and can help with ongoing IT cost management and inform investment decision making through having a detailed, granular view of IT spend.
- There are three core components that Ofgem want to see in the TBM model: a view of ongoing running costs and a forecast, direct investments that are self-funded over RIIO-2, and shared IT investments.
- The TBM is made up of four different layers: cost pools, like labour, hardware and software; IT towers, such as application, delivery and storage; product and services that are being funded; business units that inherits the benefits.

Discussion

- Energy Systems Catapult does have a smaller scale model. This looks at cost pools for the technology components that are built that flow up through the layers and ultimately into platforms (the equivalent of business units).
- The main challenge is likely to be complexity of a many-to-many set of relationships and overlaps. This can lead to long discussions about where costs should sit.
- Sometimes it is best to make a "good enough" choice about where costs sit, because there may not be an actual answer.
- It would be useful to know what Ofgem plan to do with this. Is it for benchmarking or setting targets for each area? It is important that Ofgem set a clear purpose and that the ESO is in frequent contact with them about how it is being used and what the mutual benefit is.
  - We assume that it will be used for benchmarking and to question our decisions to invest in a certain area. In addition, they may want to understand the overlaps and dependencies, or where the ESO appears to be favouring a particular solution or category.

- If a large volume of detailed information is required to be provided upfront and then regularly updated, it is important that it adds real benefit.
  - The ESO does see a lot of value in using the model. One of the main challenges is that we will not have the tools in place to fully do this for another 18 months. Currently it is being done manually and using spreadsheets.
- In the model diagram presented, it might be better to start with Layer 3: Products & Services. That would allow you to understand the total cost of change, which presumably is one of the main aims. Once you understand the costs of services, you can make decisions about how to deliver them. For EFC, say, this could be local controllers or APIs.
- The level of accuracy of what you know should determine the how much effort is put into the allocation.
  - We will need to take a varied approach to how we bring this information together. We will consider starting at Layer 3 and working backwards and forwards from this. There will be several assumptions that we will need to apply and share Ofgem so that they can see our working. Fundamentally, a degree of pragmatism will be needed.
- As the ESO transitions to the Future System Operator (FSO), the increase in IT spend that may occur needs to be understood. Participants on the demand side are persistently hearing from the ESO that the barrier to enabling full participation is IT systems. The TBM model can be used to help understand and drive spending on IT systems.
- There was limited understanding or use of the TBM model per se among TAC members, but companies are likely to be doing something similar or equivalent, perhaps with a different name.
- One of the challenges will be the transition from not doing this at all to doing it in quite a lot of detail, all in a short space of time. Ultimately it is about applying the spirit, not the letter, of what needs to be achieved.

7. Subgroups

- The Control Room of the Future subgroup had its first meeting on 26 November and will continue to meet regularly. It is chaired by Angela Wilks who is one of the Power System Managers in the ESO.
- The first session was mainly an introductory session. The Balancing and Network Control programmes were outlined and topics relevant to the subgroup remit discussed.
- Two key takeaways from the group were: 1) the need to look at exemplars in other countries and systems, and 2) whether it is worth visiting parallel control room environments in other sectors, for example telecommunications or transport.
- The Technology Transformation subgroup is in the process of being set up. It is likely to consider the Balancing Programme roadmap in some detail.

8. Next meeting and calendar

- The next meeting is scheduled for 4 March, 09:00 – 12:30.

9. AOB

- There was no AOB

The chair closed the meeting by thanking members for their participation during 2021, and for everyone who helps facilitate the meetings. The chair wished everyone a Merry Christmas and a Happy New Year.