**An interview with National Grid – moving to a decarbonised energy system**

**Q1) What challenges does the move to a more decarbonised system present to the grid?**

Decarbonisation means a significant change to the energy industry and these changes introduce many challenges including:

* Less dispatchable generation: The closure of traditional synchronous generators like coal and gas. These provided firm, flexible power and system services like voltage and stability. They were also typically used for restoration services, without them new sources to provide these services need to be found.
* More asynchronous generation: The increase in generators connected by inverter-based technologies, such as wind, solar and battery storage. These types of generators are less flexible than traditional synchronous generators and generally do not provide system services.
* More variable sources of generation: The increase in generators which are more dependent on an input to generate, like sunshine or wind, and are more prone to variability in energy output due to input variability.
* Generation moving to different areas: New generation locating at network extremities and further away from demand centres such as offshore. This puts extra strain on the system to build more grid to connect these assets and manage the movement of electricity over a larger distance.

**Q2) How much more Grid capacity do we need to get to net zero in 2050?**

Transmission grids need to increase from 2.1million km in 2021 to 12.7million km in 2050, with distribution grids needing to double to around 154million km in 2050.

**Q3) What are the consequences of not getting the grid capacity needed by 2050?**

The consequences will depend on each country and the level of grid construction that has happened. At a high level the lack of grid infrastructure will mean that renewable technologies will not be able to connect to the grid in the numbers that are needed. And those that are connected are more likely to be constrained as there is not the capacity to move the renewable capacity to where it needs to be.

This will ultimately lead to more fossil fuels being used on the system, resulting in climate targets being missed.

**Q4) What is the Balancing Mechanism?**

The Balancing Mechanism (BM) is the ESO’s primary tool to balance supply and demand on GB’s network. In the Electricity National Control Centre (ENCC), we use the BM to buy and procure the right amount of electricity required to balance the system. We do this minute by minute, second by second, to balance supply and demand in real time.

**Q5) Why does the ESO need a Balancing Mechanism?**

The role of the ESO is to ensure electricity supply meets demand second by second, which is what we mean by ‘balancing’ the grid. And when you think about how demand rises and falls throughout the day, how it is affected by weather and seasons and then about supply too, how that’s unpredictable and can change at a moment’s notice, it’s clear we need a lot of tools at our disposal. Electricity is transported to all corners of Great Britain. And properties like voltage and frequency must be carefully regulated across the whole network to ensure power generated at scale in industrial power stations can be safely used by domestic appliances plugged into wall sockets. We see to it this happens smoothly and efficiently, working with industry partners to provide ‘ancillary services’ that keep our electricity supply reliable, affordable and safe. The ESO needs to balance inertia, frequency, voltage, thermal, and constraints to name a few of the factors that go into the highly complex process of balancing the grid. The Balancing Mechanism is a market where participants can submit “bids” or “offers” into the BM. A bid is the price they’ve calculated to generate less electricity; an offer is the price to generate more. What the ENCC needs at any point in time will depend on the current system frequency. The market exists to ensure that the most economically efficient generators are dispatched to provide the balancing service.

**Q6) How will the operation of the Balancing Mechanism change to enable zero-carbon operation by 2025? For example with more automated dispatch of smaller assets**

The key to a number of our improvements across the ESO is about increasing competition where we can. One way of doing this is through increasing the number of parties able to compete, the BM is a key area to drive those changes and colleagues through the Balancing Transformation Programme are actively engaging across industry on driving systems improvements to enable this.

**Q7) Market design changes seem focused on standardisation rather than opening up markets to more participation. How you plan to mange this issue?**

Looking back at our system needs and product services document (SNAPS) we have targeted our products to be simple, homogeneous and standardised to enable efficient procurement. They key being enabling any provider of any service to compete on a level playing field with other providers, to drive competition and also critically to show the value in the services we require.

**Q8) How is the decision between Market and Network solutions to issues (such as Voltage) evaluated and how does this fit with the timescales of network investment?**

At the moment this is on a case by case basis when looking at needs. One of the big things from a number of our reform programmes across market developments and network planning is bringing these questions closer together.

**Q9) What are Balancing Costs?**

Balancing Costs are those costs associated with operating the Balancing Mechanism. Due to the complex nature of balancing the grid, there are many different segments that contribute to the overall Balancing Costs. Balancing Costs can be comprised of costs associated with the ESO’s actions in the following:

1. Restoring energy imbalances by dispatching generators to reduce generation and consumers to increase consumption during periods of oversupply, or to dispatch generators to increase generation and consumers to decrease consumption during periods of undersupply.
2. Restoring system imbalances include actions that are associated with grid constraints to ease congestion along certain parts of the grid, minute-to-minute and second-to-second variations between demand and supply, and any other costs associated with dispatching generators to balance the system’s voltage, inertia, thermal, and frequency parameters on an immediate time-scale.

The prices at which these services to balance the grid will depend on the submitted bids and offers into the Balancing Mechanism. These bids and offers are submitted by the market participants. The ESO dispatches in merit order to ensure system security is always maintained. The BSUoS charge recovers the cost of balancing the electricity transmission system.

**Q10) The stability market design group only focusses on synchronous machines, so where are you promoting grid forming?**

As with all our markets, we aim to be as agnostic to technology types as possible, given the technological parameters of different types of assets. We hope that we will be able to access grid forming technology through these future markets, which will include a short-term DA type market. We envisage this may be an ideal way to access Grid Forming.

**Q11) Today big SynCons are installed to provide grid strength, big machines = big no-load losses you need to start. Do you need these units during restoration?**

We run tenders for our restoration services so this can be provided by various different technology types. Given the nature of these contracts, we don’t publish any further details on which assets we have contracts with. It’s probably worth just saying that to restore the system effectively, we will need a range of different technology types with a range of technical parameters.

**Q12) Do you think the Transmission Network needs more investment beyond the 94 projects recommended in the HND? How is operability being considered in investment/cba**

The ETYS and NOA annual process drive the network build requirement. The HND and NOA refresh has recommended the 94 projects based on economics. However we note in the report that future network planning will likely require a move to more strategic and anticipatory investment, in order to keep pace with connecting generation.

**Q13) Have you considered the opportunity for reactive power contributions from battery storage systems? Could play a significant role in voltage management?**

Battery storage systems at transmission level are required to provide mandatory reactive power services. In addition, we have seen that batteries often have more capability than is mandated (for example we have contracted with a battery in the Mersey region through the voltage pathfinder). Therefore, our reactive power market programme is looking into how we can effectively access reactive capability such as this in the future. However, it is clear that batteries will play a key role in managing voltage on a zero-carbon system.

**Q14) Is it the ESO or the DSO that procures local flexibility?**

I think the answer to this will be both. The ESO and DSOs both need flexibility to operate the systems they are responsible for.

When we are talking about Within-Day Flexibility we are mainly thinking about energy balancing, which is the ESO’s responsibility, but over time the same flexibility will be used for an increasing list of needs and services, including network services that both the ESO and DSOs need to manage.

Also, the majority of the new sources of flexibility will be connected to Distribution Networks. So, whoever is buying the flexibility, the ESO and DSOs are going to need to work together, so that we can both see what is going on and use the flexibility efficiently.

The rules governing how the ESO and DSOs will coordinate their use of distributed flexibility assets are referred to as “Primacy” rules. You can find out more about this on the ENA website.