nationalgridESO

Zero Carbon Operation 2025

Executive summary

Great Britain needs to decarbonise its energy system to help address the ever increasing threat of climate change. A key element of this is to move to lower, and even zero, carbon emissions for the electricty system. Over the past decade the electricty system has been reducing its carbon intensity and GB has been leading the way among the major world economies in this regard (Ref). However, there is a need now to make a step change in how we plan and operate the electricity system to enable ever higher levels of renewable and sustainable energy in our national energy mix.

There soon will be times in the year when the market could meet the total demand for electricity through renewable generation only and these periods will increase as more and more renewables are connected and more load actively participates in the market. This is very different to the traditional model of power system operation and, to enable all of this low carbon generation operate unconstrained, requires us to address and solve some critical engineering challenges.

Today, to manage this system safely and securely, we need to bring on conventional power plants (typically gas or coal plant) to provide key system and balancing services such as voltage control, inertia and frequency response (high and low). Our ambition is that, by 2025, we will have transformed the operation of the electricty system such that we can **operate it safely and securely at zero carbon** whenever there is sufficient renewable generation on-line and available to meet the total national load.

Zero carbon operation of the electricity system by 2025 means a fundamental change to how our system was designed to operate – integrating newer technologies right across the system – from large scale off-shore wind to domestic scale solar panels to increased demand side participation, using new smart digital systems to manage and control the system in real-time.

We will identify the systems, services and products we will require to run a zero-carbon network and design the new competitive marketplaces needed to source these as efficiently as possible from both new and existing companies. We believe that promoting competition will ultimately lead to better value for consumers. The new products and services we will introduce will help reduce the overall cost of operating the system, driving down costs for consumers.

We recognize that tranforming the electricity system so that it can operate at zero carbon is ambitious and challenging and will require us to work collaboratively, and gain the support of parties, across the industry and beyond. However we believe this transformation is achievable and, if we are to make progress in addressing climate change, essential.

Author: Julian Leslie – Head of National Control

The Report

How the System is Operated

In operating the system today in a safe and secure manner we typically need to schedule some conventional generation (e.g., gas and coals plants) so that we have the essential services necessary to ensure safe, secure and reliable system operation (e.g., inertia, frequency response etc.) as we cannot source what we need today entirely from renewable energy sources. This, at times, leads to some renewable generation that would otherwise be available being constrained off. This has a cost to consumers and increases the carbon intensity of the electricty system at that time.

To enable operation of the electricity system at zero carbon, when there is the renewable generation available to support this, we need to fundamentally change how we plan, analyse and operate the electricty system and innovate in the development and deployment of new technologies, products and services.

Key challenges that need to be addressed:

In order to operate the electricity system at zero carbon, there are a number of key challenges that need to be addressed.

Frequency Management

Frequency management will become more volatile as we operate a low carbon network hence we will need to complete the ROCOF and Vector Shift protection changes, and new services that supply fast frequency response and the ability to confidently hold reserve and response on wind and solar generation sources.

Actions:

1. The process for changing the ROCOF and Vector shift protection changes in underway with approval agreed from Ofgem on the approach and funding
2. Enhanced Frequency Control Capability NIC Project – this project is just finishing and has explored the frequency response cability required an the network and how renewable technologies can assist
3. Implementation of Power Available for wind and solar so that reserve and response can be held on these renewable technologies – deliver 2020
4. Increased deployment of new storage technologies can provide access to a whole range of frequency products – continuing enhancments to the frequency markets

Inertia and Short Circuit Infeed

To ensure a stable and secure network there needs to be sufficient inertia and short circuit infeed, this will also ensure that the HVDC links and TO asset protection functions correctly. To deliver this new ancillary services will need to be defined and market structures put in place to procure new technologies that we currently don't have installed on the GB system.

Actions:

1. Deliver the Stability Pathfinder in summer 2019. This explores the definition of grid stability and will allow us to understand what the market can deliver.
2. Complete a tender exercise to deliver the Stability Pathfinder outcome

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3. Develop the full technical definition of the services and products we need to provide inertia, short circuit infeed and stability, complete end of 2019
4. Produce the regional requirements and engage with the market to explore the innovative technological solutions
5. Complete the market tender process by 2022 to allow for the design and build of new technologies

Voltage Management

Static and dynamic voltage support will be required to ensure that voltage limits stay within the operational limits of the equipment installed on the networks both pre and post fault. This could be conventional TO equipment, or new technologies provided by the market. It is expected that these new technologies may provide many of the new services required and therefore packaging or layering of services will be required.

Actions:

1. Deliver on the whole system voltage pathfinders during spring 2019
2. Complete the market tender process for both short and long term voltage solutions in selected GB regions
3. Assess how the voltage and gird stability markets can work together
4. Roll out further whole system voltage pathfinders to the voltage constrained parts of the network

Situational Awareness

It is expected that to manage the system with no carbon sources that more data and information will need to be managed and processed by the control room, possibly through utilising new data management techniques. Alongside this more system real-time and planning tools will be required to look at a range of probabilistic scenarios and real-time management of the network.

Actions:

1. Enhance the forecasting tools for wind, solar, embedded and transmission using AI and machine learning techniques
2. Deliver the ability to measure and monitor system intertia
3. Using the results fine tune the amount of intertia that is required
4. Continue the development of the offline network analysis tools such that multiple scenarios can be assessed and a robust plan developed and delivered into real time

Marketplaces

To manage the GB electricity network with zero carbon energy sources will require a step change in how the system is modelled to identify the current and future needs and will require a whole new suite of products and services to be procured through new markets. We know, through approaches that we have had to date, that there are customers with the right technologies that can provide these services. Therefore, once we have identified and described the technical requirements of the network it should be possible to create the right products and market place to procure.

Proposed timeline

Summer 2019 Pathfinder stability project request for information

Winter 2019 Stability pathfinder RFI and tender process completed

Winter 2019 Funding routes and contract terms agreed

Summer 2020 Inertia/Grid Stability market launched

Summer 2020 Analysis complete to define requirements for low carbon operation

Winter 2020 Priority areas identified and market solutions procured

Summer 2021 Project Pheonix results known, stability pathfinder technology operational

Summer 2022 First round of intertia/grid stability solutions operational

Summer 2023 Tender process complete and contracts issued for technology providers

Summer 2024 BM Systems and situational awareness updates implemented

Summer 2025 Low Carbon Operation

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