The Electricity System Operators Response to Heat Resilience & Sustainable Cooling inquiry by the Environmental Audit Committee

Introduction

As the Electricity System Operator (ESO) for Great Britain, we welcome the opportunity to submit a response to your inquiry. Our role is to operate the national electricity transmission system, whilst building a secure, clean, and fair system for tomorrow. We move electricity around the system, procuring services to balance demand and supply second by second, 24/7. We do not generate or sell electricity, or own and maintain any infrastructure, as the system operator we ensure fairness is at the heart of how we manage the system by remaining impartial and basing our decisions on consumer outcomes.

We work in partnership with Government, Ofgem, industry and consumers to guide Great Britain (GB) on the energy resources, markets and networks required to securely accelerate the transition away from fossil fuels. The ESO will make net zero carbon operation of the electricity system technically possible for short periods by 2025. By 2035, providing the market supplies a 100% renewable generation mix, we will operate a net zero carbon electricity system all the time.

We are currently transitioning into an independent public body, with responsibility for advising government across the whole energy system as it transitions to net zero, from strategic network planning across electricity and gas to new vectors such as hydrogen. The intent is for the Electricity System Operator to be at the heart of the FSO, which will build on the ESO's track record and world-leading expertise.

Executive Summary

- During the heat periods in 2022 and 2023, coal formed a very small proportion of the energy mix[1].
- The ESO is working towards operating a fully decarbonised electricity system by 2035, and we are on track to deliver our 2025 ambition of operating a zero-carbon GB electricity system for short periods of time.
- The demand for cooling in GB is growing, which follows a general trend towards a significant and steady rise in annual electricity demand.
- Cooling demand will play a role in our long-term planning of demand in the future, however heating demand has a higher focus due to the challenges in demand during winter.
- Cooling demand is expected to grow in the next few years, alongside solar generation capacity and heat flexibility, therefore cooling load could be managed in a similar way to heating load.
- Some areas of GB may be able to meet their own summertime peak electricity demands solely through renewable distributed generation, but this capability will reduce on days where there is less sunshine and across the whole of the winter.

Why is coal still running on the electricity system?

1. To deliver a zero-carbon electricity system, one of the first major milestones set by the Government is to completely stop generating electricity using coal by October 2024. As the Electricity System Operator, we're actively planning for this by introducing new products and services that will replace coal in the GB generation mix. Coal has currently made up 0.61% of the GB electricity mix in 2023, with over 3,000 coal free hours[2].

2. As the ESO, we're responsible for balancing the electricity system, therefore we consider a mixture of energy sources that are provided by the open market, in which coal is part of that mix. Coal is considered in the mix, as the market doesn't always provide the most viable option, meaning there is not enough weather-dependent types of energy available at that point in time to balance the electricity system. It can also be driven by the location of weather-dependent energy; if it is too far away from the

[1] Electricity System Operator, Historic GB Generation Mix, 2023.
[2] Electricity System Operator, Control Room Operations, 2023.

location of demand, it can result in higher costs to locate it to that area of demand. This consequence leads to the decision to take the lowest cost options available to us to balance and secure the system. Throughout the summers of 2022 and 2023, coal has formed a small proportion of the energy mix used to balance the electricity system, as seen in Figure 1a and 1b[3].

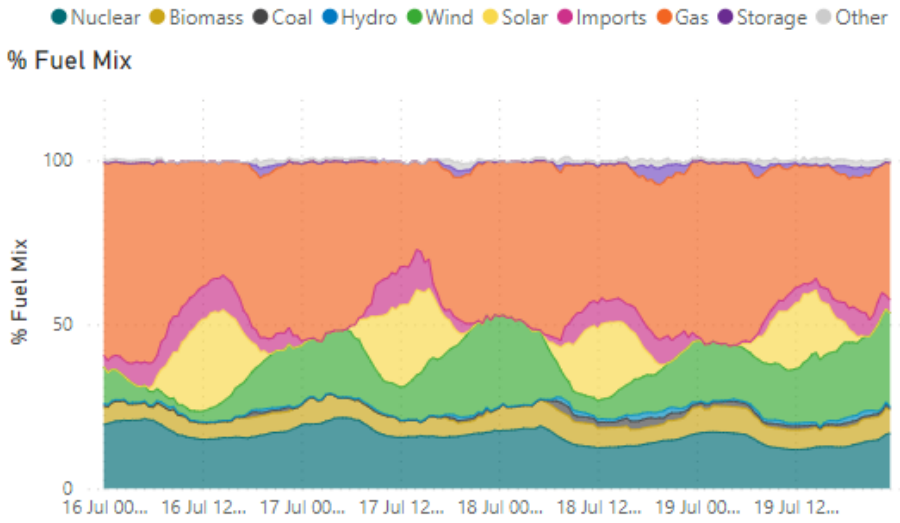

Figure 1a: The energy mix in (%) during the heat period between 16th July- 19th July 2022[4].

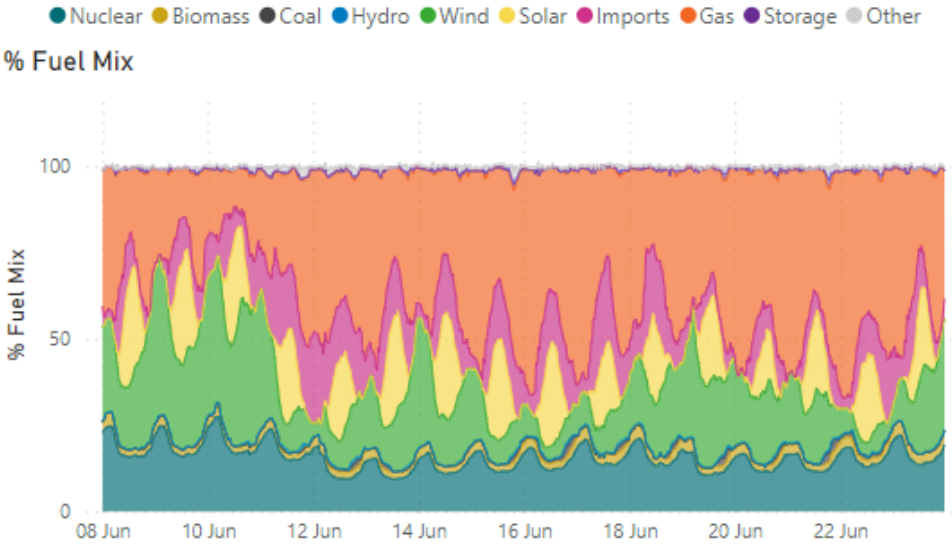

Figure 1b: The energy mix in (%) during the heat period between 8th June- 22nd June 2023[5].

How the electricity system operates

3. GB has one of the fastest decarbonising electricity systems in the world. The ESO is working towards operating a fully decarbonised electricity system by 2035. We are also on track to deliver our 2025 ambition of operating a zero-carbon GB electricity system for short periods of the time, whenever the market presents us with a safe, operable 100% zero carbon mix.

[3] Electricity System Operator, Historic GB Generation Mix, 2023.
[4] Electricity System Operator, Historic GB Generation Mix, 2023.
[5] Electricity System Operator, Historic GB Generation Mix, 2023.

4. As more renewable energy generation is connected to the electricity system, and the use of traditional fossil-fuelled power plants are reduced, new methods of delivering essential services to keep the system stable are required, Currently, our engineers need to frequently draw on fossil-fuel power plants to deliver system reliability. To keep the electricity system balanced is a highly complex process dependent on a range of factors, including inertia, frequency, voltage and thermal constraints. Properties like voltage and frequency must be carefully regulated across the whole network to ensure power generated at scale can be used safely. Inertia is important to the stable operation of the electricity system, providing a buffer in sudden changes in system frequency while our control room restores balance. As supply and demand change, this impacts frequency. For example, if there's more demand for electricity than supply then frequency will fall, but if supply is higher than demand, frequency will rise. Therefore, we are pioneering world-first new approaches and technologies[6].

5. We have invested £336m in green stability solutions onto GB's electricity system to date[7], with £323 million to grid stability projects in Scotland.. They are part of an investment programme to measure and generate "green" inertia, which is needed to maintain frequency on Britain's electricity system, keeping it stable. Green inertia is procured from carbon free sources, which is not only significantly cheaper for consumers, but allows for greener system operation and more renewable energy to run. In January this year (2023), we operated the transmission system with 90% of the energy coming from zero carbon sources, and that may reach 95% this year[8].

Long-term planning of future demand for active cooling

6. We publish analysis on a range of different, credible ways to decarbonise GB's energy system, known as the Future Energy Scenarios (FES). Our analysis considers cooling demand, particularly in our modelling for commercial and residential buildings[9]. However, we are considering cooling to be a broader part of our long-term planning, to ensure a more credible base for planning in the future. The demand for cooling in GB is growing, which follows a general trend towards a significant and steady rise in annual electricity demand[10]. Energy demand, or annual demand, relates to how much we use through the year as a total, ensuring we have enough through the year from various sources. Figure 2a highlights how we expect annual electricity demand to grow by between 100% and 150% between now and 2050[11]. Similarly, this range accommodates what the IEA expect to see for cooling demand[12].

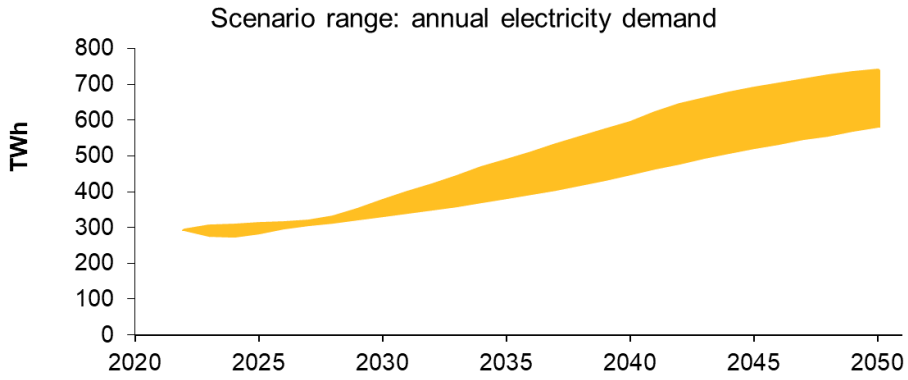

Figure 2b: Annual Electricity demand in (TWh) from 2020-2050[13].

[6] Electricity System Operator, Pathfinder Projects to Stabilise the System, 2023.
[7] Electricity System Operator, Green Inertia Projects, 2022.
[8] Electricity System Operator, Control Room Operations, 2023.
[9] Electricity System Operator, Future Energy Scenarios, 2023.
[10] Electricity System Operator, Future Energy Scenarios, 2023.
[11] Electricity System Operator, Future Energy Scenarios, 2023.
[12] International Energy Agency, The future of Cooling, 2018.
[13] Electricity System Operator, Future Energy Scenarios, 2023.

7. Understanding the changes to GB's peak demand will form part of wider long-term planning. Peak demand is highest electrical power demand that has occurred over a specified time-period. As weather-dependent generation will form a greater proportion of GB's generation mix, peak demand will be considered in a different light. For example, peak system stress may not occur on a cold dark day like it currently does.

8. Much of our current modelling focuses on whether GB have enough generation capacity to meet demand based on a peak demand occurring in winter. This is due to winter peak demand posing more challenges than in the summer. We are confident there will be sufficient supply to meet electricity demands over the summer and we will be able to meet operability challenges.

Tools in managing future cooling-related peaks in energy demand

9. Electricity generation connected to electricity distribution networks will play an increasingly important role as growth in demand continues through the 2030s. Today generation connected at distribution level includes a wide range of technologies, from household rooftop solar PV (Photovoltaic) panels to onshore wind turbines, solar farms, local hydroelectricity schemes and fossil fuel peaking plants. Our analysis[14] shows GB has around 13 GW of solar, 6 GW of onshore wind and 11 GW of small dispatchable generators (including Combined Heat and Power units, (CHPs) currently connected to the distribution network[15]. Dispatchable generation refers to sources of electricity that can be programmed on demand at the request of power grid operators, according to market needs. Solar generation is a major contributor with an ambitious pipeline of development for distributed generation in several regions.

10. Higher levels of renewable distributed generation help empower consumers and increase local self-sufficiency but also bring challenges in operating a fair and efficient system with many smaller participants. Electricity flows will be higher and increasingly complex, in which these balances may shift in different regions and at different times of the day or year. It will become increasingly important to consider the effects of these local peaks on both the transmission system and the regional mix of technologies.

11. Some areas of the country may be able to meet their own summertime peak electricity demands solely through renewable distributed generation, but this capability will reduce on days where there is less sunshine and across the whole of the winter. Solar use can be maximised locally when it is able to meet demands that peak in summer, such as in areas with higher air conditioning demand. There are technological and market solutions to many of these challenges, but different solutions are appropriate for different areas depending on their generation portfolio.

12. There are future opportunities for different types of consumers to participate in reducing their peak electricity demands. This will work well for regions with large and variable electricity demands, but for other regions there may be a greater need to invest in storage technologies or reinforcement of network infrastructure.

13. Whilst cooling demand is indeed expected to grow, so too is solar generation capacity and heat flexibility. Solar PV output will likely correlate with AC loads, which will be an important tool in managing cooling-related peaks in energy demand. However, throughout summer, we will still experience cloudy skies which can impact solar PV load, and a lot of AC load will be at night when people want a lower temperature to help them sleep, which we would need to consider. Flexibility of a few hours' duration, such as batteries and smart EV charging can further improve managing cooling-demand.

October 2023

[14] Electricity System Operator, Future Energy Scenarios, 2023.
[15] Electricity System Operator, Future Energy Scenarios, 2023.