Resource Adequacy
in the 2030s

Demand-Side Response Spotlight Study

July 2024

ESO

Table of Contents

Introduction

We published our first study assessing resource adequacy in the 2030s with AFRY in December 2022. This study considered the potential risks to resource adequacy for a fully decarbonised power system and how different portfolios of resources could provide adequate electricity supplies, when over 80% of annual electricity generation could be from weather-dependent resources.

We are now working on our next study assessing resource adequacy in the 2030s, which is expected to be published later this year.

To support this study, we have continued to engage with stakeholders–most notably through an expert advisory group–and developed in-house modelling capability through a new Net Zero Adequacy Modelling team in the ESO.

Ahead of the next study, we also wanted to explore a few areas of interest through some shorter 'spotlights'. We recently published one exploring the approaches and metrics used to assess resource adequacy.

Here we focus on demand-side response (DSR). This was one of the main themes arising from our round-table debates with stakeholders following the study with AFRY. This was set out in an update *Planning for Further Studies*.

In this spotlight, we first look at the role DSR has to play in resource adequacy as the power system becomes fully decarbonised. We go on to explore how DSR can be modelled by considering the assumptions that influence our modelling approach.

The result of this exploration highlights the impact certain assumptions on DSR have on resource adequacy. It also invites a call for greater understanding, collaboration and transparency for the DSR that operates within Great Britain.

Ahead of the next resource adequacy study, we are intending to provide further spotlights setting out the technology and modelling assumptions we will use for our upcoming study.

As ever, we invite feedback and welcome engagement with stakeholders. The best way to contact the team or main author is by email at: Box.NetZeroAdequacy@nationalgrideso.com or timothy.price@nationalgrideso.com.

Timeline of ESO activities on resource adequacy in the 2030s

Dec 2022	First study, *Resource Adequacy in the 2030s*, published with AFRY.
Mar 2023	Stakeholder engagement and feedback on first study.
Jul 2023	Published an update, *Planning for Further Studies*, responding to stakeholder feedback along with plans for the next study, spotlights and establishing an external expert advisory group.
May 2024	Spotlight published: *Exploring approaches and metrics to assess resource adequacy in a fully decarbonised power system*.
Jul 2024	**Spotlight exploring the role of demand-side response (DSR) in adequacy.**
Jul 2024	Spotlights exploring the technology and modelling assumptions for our next adequacy study.
Autumn 2024	The next ESO study assessing resource adequacy in the 2030s.

1. DSR: A Potentially Increasing Role in Adequacy

DSR occurs when a consumer from any sector (domestic, commercial or industrial) reduces or shifts their power consumption in response to market signals. This reduction or shift in consumption can occur as a literal change in consumption (like turning off lights or delaying cooking), or power can be provided by another source not visible to the ESO (like a backup generator).

Figure 1 shows there is currently less than around 2 GW of DSR in operation across domestic, commercial and industrial consumers. This is expected to grow significantly through the 2030s. There will also be new opportunities for DSR through the decarbonisation of our energy system. Examples of new opportunities include transport flexibility through smart charging and Vehicle-to-Grid, and heat flexibility through low-carbon heating technologies, neither of which is shown in Figure 1.

In terms of adequacy, we are most interested in how DSR operates in periods when margins are tight. Historically, this has been for short periods over the evening peak on weekdays during winter, often incentivised through Triad Avoidance. In the future, the role of DSR could be very different. This is because potential tight periods on a power system with a higher proportion of weather-dependent resources could become longer, driven by weather patterns.

Consumer engagement will play a crucial role in the future, and it will be increasingly important to better understand certain aspects of DSR. For example, the potential volume of DSR; how long and often it can be provided; and whether the DSR is a reduction or a shift in consumption. Our Demand Flexibility Service (DFS) has already demonstrated that consumer demand flexibility can be provided at a national scale, and further industry-wide programmes, such as the Market-Wide Half-Hourly Settlement (MHHS) reform, should also enable further consumer demand flexibility.

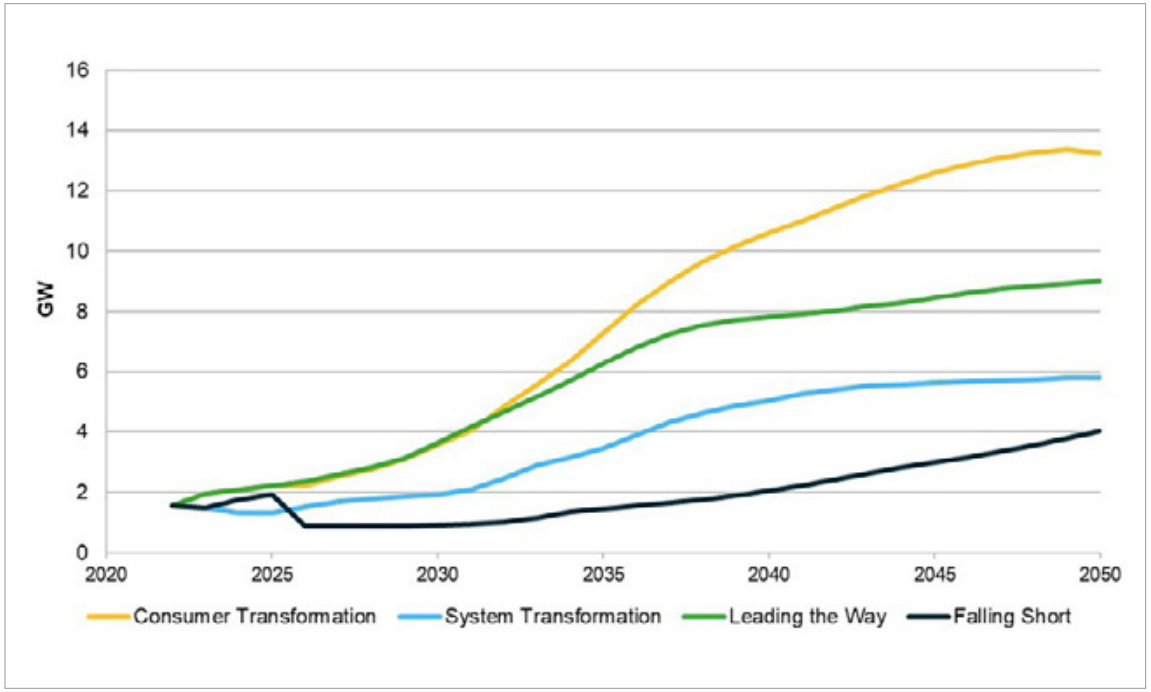

Figure 1: DSR from residential, commercial and industrial sectors in our 2023 *Future Energy Scenarios*. This does not include DSR from transport and heat flexibility.

2. DSR Modelling Assumptions

We use software called PLEXOS to model resource adequacy. We use it to simulate supply and demand in both Great Britain and Europe, hour-by-hour throughout a future year of interest under a variety of historical weather conditions. This method of modelling means we can explicitly assess the impact of prolonged, extended weather patterns across Europe and observe any potential limits to resources under the given scenarios created. In our case, we can observe the extent to which DSR is utilised under weather conditions that could cause stress to the GB power system (which we term “stress events”).

Currently, however, modelling DSR contains a great deal of uncertainty. For example, DSR is made up of different types of DSR that could be from domestic, commercial or industrial consumers. Individual DSR unit sizes are often much smaller than generators, and the ESO has historically had less visibility of, and less data available for, these resources. This uncertainty means that the ESO has to make assumptions about key characteristics of the resource when assessing security of supply. Table 1 sets out the different types of modelling assumptions that must be made.

While there is scope for some segmentation in the modelling assumptions (e.g. assumptions on transport flexibility), due to the uncertainty, our assumptions can often be quite broad in nature. This could be, for example, assuming all DSR operates with the same maximum duration or frequency.

Clearly, such broad assumptions cannot fully reflect the diverse nature of different types of DSR. These assumptions will also have a material impact on the outcomes of our adequacy studies. On the next page, we demonstrate the importance of this through an illustrative example showing how two different sets of DSR assumptions impact an adequacy assessment.

Table 1: Different types of assumptions made for DSR in our adequacy modelling.

Assumption	Description of the assumption
Total available DSR capacity	The maximum volume of DSR capacity that can be used to support adequacy. The higher the capacity, the greater potential support DSR can provide.
Maximum duration of DSR	The maximum duration for which we assume DSR can operate for. This considers that consumers may not be able to reduce or shift their consumption indefinitely.
How often DSR can be used	The frequency for which we assume DSR can be operated at. This considers that consumers may only be able to reduce or shift consumption once every X hours or days etc.
Proportions of DSR reduction and DSR shifting	The proportions of DSR capacity that operate as a reduction in demand as opposed to a shift in demand. The sum of these result in the total available DSR capacity.
Maximum delay for demand shifting	The maximum duration for which DSR operating through demand shifting can be delayed. This considers that consumers shifting their consumption may not be able to shift their consumption indefinitely.
DSR utilisation price	The electricity price in the PLEXOS model at which we assume consumers will operate DSR. A lower price here means DSR is utilised more frequently and maybe even ahead of other technologies. A higher price reduces how often it is used.

3. Illustrative Example: The Impact of DSR Assumptions on Our Adequacy Studies

Here we show an illustrative example that demonstrates the importance of DSR assumptions on our adequacy studies. The assumptions have been chosen for this illustration to highlight the potential impact of these assumptions, rather than a prediction on how we actually expect DSR to operate.

Table 2 sets out two approaches we have taken to assess the impact of DSR assumptions on adequacy. Each approach has a different set of DSR assumptions, although both have the same DSR capacity.

We have assessed the impact on adequacy through loss of load expectation (LOLE) and expected energy unserved (EEU) for the years 2025 and 2035.

With the exception of the assumptions in Table 2, all other assumptions for the two cases are identical and based on those in the Consumer Transformation (CT)[1] scenario in the ESO's 2023 Future Energy Scenarios (FES).

We scaled the demand in the scenario such that the LOLE was in the range 1–2 hours per year in Approach 1 for both 2025 and 2035. We used one historical weather year (1985) in both cases, as this year was shown to contain significant weather-driven stress events in the AFRY study.

This illustrative example highlights two key points:

1. Our modelling assumptions on how DSR operates have a significant impact on the adequacy outcomes, as evidenced by comparing the LOLE and EEU values between both approaches.

2. Our modelling assumptions on how DSR operates will become even more important for a fully decarbonised system with higher DSR capacity. This is evident as the relative increase in LOLE and EEU from Approach 1 to Approach 2 is much higher for 2035 than 2025.

1 We chose CT to be in line with the 2022 AFRY Resource Adequacy study

Table 2: Assumptions and results for an illustrative example that demonstrates the importance of DSR assumptions on adequacy.

Method	DSR capacity	Max. duration of DSR	How often DSR can be used	Reduction – shift mix	Max. delay for shifted demand	DSR utilisation price	LOLE (hours per year)		EEU (GWh)	
							2025	2035	2025	2035
Approach 1	As per CT scenario in FES 2023	No limit	No limit	100% reduction	N/A	Price set such that DSR used for 5% of the year	0.96	1.94	0.8	5.07
Approach 2	As per CT scenario in FES 2023	2 hours	Once every 12 hours	50% reduction 50% shift	4 hours	Price set such that DSR used as last resort	6.57	24.0	10.1	191

4. Improving Our Modelling through Greater Collaboration

The illustrative example in this spotlight has shown the importance of our DSR assumptions on adequacy. It has also highlighted an opportunity for us to be more transparent about the assumptions we are making.

While there is often a focus on the total DSR capacity, the modelling assumptions on how DSR will operate are also critical. In our illustrative example, we had the same DSR capacity in both cases, but the two approaches had very different LOLE and EEU results.

We believe that greater transparency about our assumptions will better inform industry stakeholders. This could help support energy policy development and shape future market design.

Greater transparency will also provide more opportunities for stakeholders to scrutinise and challenge our assessments. They will be able to compare our assumptions with their evidence and experiences. This could help us refine our assumptions and potentially support the development of new datasets through collaboration.

We recognise that the ESO has a role to play in acquiring this data and has started to do so with findings from the Demand Flexibility Service and will investigate consumer behaviour further with the Crowdflex project.

We will make a commitment to be transparent on all our assumptions, including DSR, in our next resource adequacy study, which is due to be published this autumn. We would be keen to hear any feedback on this, including views on whether there are any additional DSR assumptions that are potentially important but have not been discussed here.

Summary of key points

1. DSR has an important role in supporting adequacy today and is expected to become even more important in the future.

2. There is uncertainty in modelling DSR and so we have to make assumptions. These assumptions have a significant impact on the outcomes of our adequacy studies.

3. There are opportunities for us to be more transparent and to improve how we model DSR through greater collaboration with stakeholders.

Electricity System Operator
Faraday House
Warwick Technology
Park Gallows Hill
Warwick
CV34 6DA

Registered in England and Wales
No. 11014226

nationalgrideso.com

ESO