

# Long Duration Electricity Storage

## Response to DESNZ Request for Advice. Q3 (Part 2)

### Context

NESO was asked by DESNZ to provide advice on the proposed Long Duration Electricity Storage (LDES) cap and floor scheme, in accordance with our statutory duty set out in section 171 of the Energy Act 2023. The request was split into three core questions:

1. Provide advice from an electricity system perspective on the costs and benefits of:
  - a) Increasing the minimum duration for a qualifying LDES asset to beyond 6 hours, and what an optimal minimum duration might be.
  - b) Lowering the minimum capacity required for eligibility for Stream 2 projects.
2. Outline the full range of electricity system benefits and costs from LDES which Ofgem should take into account when assessing project cap and floor applications.
3. Identify the amount of LDES capacity, which can be expressed as a range, that would be optimal for Ofgem to support with cap and floor agreements through its first LDES allocation round to open in 2025. In particular, how much additional LDES cap and floor capacity beyond that in your clean power 2030 advice would be optimal to maintain clean power and energy security in the period from 2030 to 2035.

In January 2025, we provided our [Long Duration Electricity Storage Advice](#) to DESNZ and Ofgem. Our advice was delivered as two reports:

- The first, [Long Duration Electricity Storage Response to DESNZ Request: Q1 and Q2](#) addressed DESNZ's first two questions and set out the general definition and context regarding LDES, including our summarised views on its role in the system, which provides broader context relevant to this report.
- The second, [Long Duration Electricity Storage Response to DESNZ Request for Advice: Q3 \(Part 1\)](#) addressed DESNZ's third question but was based on pre-existing modelling and analysis rather than being optimised against system cost.

These outputs supported DESNZ and Ofgem in delivering their [Long Duration Electricity Storage: Technical Decision Document](#) for Window 1 of the scheme.

When we delivered this initial advice, we committed to exploring ways to refine the optimal capacity range using our enhanced modelling capabilities being developed to deliver the Strategic Spatial Energy Plan (SSEP) (referenced as ‘Question 3, Part 2’). The further sophistication of our Capacity Expansion Model (CEM)<sup>1</sup> enables us to explore cost-optimised pathways for the capacity and timing of LDES deployment among a wide range of generation and storage assets, while accounting for a range of factors such as security of supply, varying weather years, and geospatial considerations. Some potential system benefits from LDES, such as increased liquidity in ancillary services markets, are not included in the CEM and need to be considered alongside the cost-optimisation modelling.

The advice provided here and in the preceding reports described above focus on the total LDES capacity required in Window 1 and overall system benefits. The capacity expansion modelling carried out uses generic cost and efficiency assumptions for individual technology categories and is suitable for assessing the aggregate role of LDES in a least-cost system but is not intended for site-specific project comparisons.

In a separate but complementary piece of analysis NESO also assessed individual LDES project applications for the Cap and Floor scheme using a Marginal Additional Framework. These two pieces of work answered different questions and therefore used different approaches; the methodology used for the assessment of individual LDES projects can be found on [Ofgem’s consultation page](#).

## Modelling context

Our enhanced CEM modelling work relies on cost and technical input data from DESNZ. As we explained in an [open letter to industry](#) on 20 November 2025 and subsequent update, DESNZ has refreshed and published this input data. NESO and DESNZ agreed to re-run the CEM analysis for the SSEP with the most recent data to ensure all outputs are as robust as possible and that the inputs are publicly available. We also used this period of updating the input data to make further enhancements to the modelling approach based on learnings from the previous round of analysis.

It has not been possible to base our optimal range for LDES advice on the final shortlisted pathways to be refined and presented as part of the SSEP, because these are not available with the updated data in the timescale required to inform Ofgem’s next steps. However, we have interim modelling results using the updated data and our enhanced CEM capabilities that can help give an understanding of cost-optimised LDES deployment under different conditions.

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<sup>1</sup> Our CEM is implemented in the PLEXOS software; equivalent capability can also be implemented in other software used within our industry, such as Bid3

## Updated advice

To provide further advice while model development continues, we have reviewed our previously recommended range to assess whether it remains appropriate for Window 1.

This report provides our advice for 'Question 3, Part 2' and addresses some additional questions from Ofgem received since then.

## Recommendation on range

**We consider that the previously provided recommended range remains appropriate for procurement under Window 1, which is an additional 2.7 – 7.7 GW by 2035 on top of existing capacity (2.8 GW).** The relevant details of the previous advice are set out in Table 1 below. The energy range (GWh) was carried over from our earlier recommendation and is complementary information, however, note that our most recent capacity expansion modelling and advice provided to Ofgem implies that the GWh range would be higher than in Table 1.

*Table 1 – Summary of total LDES capacity ranges for 2030 and 2035 in terms of both power and energy capacity. Both total (including 2.8 GW/28 GWh of existing capacity) and additional values are shown.*

Year	Based on	Total capacity (including LDES assets)		Additional capacity required	
		Power capacity	Energy capacity	Power capacity	Energy capacity
2030	Range in CP30	4.6 – 7.9 GW	50.1 – 98.5 GWh	1.8 – 5.1 GW	22.1 – 70.5 GWh
2035	Range in FES 2024	5.5 – 10.5 GW	62 – 120 GWh	2.7 – 7.7 GW	34 – 92 GWh

## Rationale for recommending this range:

- Robustness of previous analysis:** The recommended 2035 range was based on the upper and lower bounds for 2035 of the Future Energy Scenarios (FES) 2024 pathways that achieve Net Zero by 2050. The recommended 2030 range represented the two modelled pathways for Clean Power 2030 (CP30). The FES 2024 and CP30 publications represent the output of a significant body of our wider work that has drawn heavily on input from key stakeholders across the energy sector and has involved consultation with technology developers to inform both pathway modelling and deliverability analysis.
- Clean power by 2030:** The Clean Power mission by 2030 has not changed since our previous advice, and we therefore think it is appropriate for the range for LDES by 2030 to remain at

the same level of ambition. We also note that the original question to NESO is explicit that the range being requested should be building on the clean power by 2030 mission: “In particular, how much additional LDES cap and floor capacity beyond that in your clean power 2030 advice would be optimal to maintain clean power and energy security in the period from 2030 to 2035.”

- FES 2025 range:** FES 2025, published in July 2025, has undergone the same robust process as FES 2024 for its modelling methodology, stakeholder consultation, and quality assurance. Since FES 2024 we have engaged with more than 84 organisations and 144 stakeholders to further refine our modelling. FES 2025 emphasises the importance of LDES to the energy system for longer-term flexibility and additional operability needs, and gives a partly overlapping range compared to FES 2024 of 4.7 – 7.7 GW of additional LDES capacity by 2035. The outputs from the interim CEM modelling results below include some LDES capacities below the FES 2025 range. These represent a minority of the results but their presence has been considered in our decision *not* to update the minimum of the recommended range. As set out further below, while we do not consider that the interim CEM modelling results should be used to revise the recommended range, we do consider that the emerging results support not narrowing the range from FES 2024 to align with FES 2025.
- Interim CEM modelling:** While the SSEP analysis is still in progress and the results presented in the SSEP pathways may be different, this report presents interim modelling insights utilising our enhanced CEM capabilities. These findings have helped us to test the appropriateness of the recommended range. The outputs from this interim modelling indicate that the medium to upper bound of additional LDES deployment in the recommended range is more likely to be cost-optimal for GB for the Window 1 period. However, as noted above, the outputs from the interim CEM modelling results also include some LDES capacities below the FES 2025 range. Given the interim nature of the modelling outputs, they are not sufficiently comprehensive to support a narrowed recommended range. However, the interim CEM results have been taken into account to provide further confidence in the previously recommended range, given they provide early insight into our cost-optimised modelling of LDES deployment. Additional details on these interim insights are provided below.

### Further detail regarding interim CEM modelling

As part of our ongoing modelling work, we have added further sophistication to our CEM so that it has the capability to optimise the technology, capacity and timing of commissioning and retirement of assets, such as electricity generation and transmission network assets.

### **CEM explained**

Capacity expansion modelling identifies the lowest-cost solution by considering constraints like carbon emissions, input costs over multiple weather years, and geospatial limitations. The types of **cost inputs** include:

- The capital cost of new assets, with the economic life and weighted average cost of capital
- Fixed operation and maintenance costs
- The production cost of an electricity generator, which includes fuel costs, carbon costs and variable operation and maintenance costs

**Asset capabilities data** includes lifetimes, plant efficiency (charge and discharge efficiency for storage assets), storage duration and minimum stable load (the lowest output level at which a generating unit can operate continuously and stably without violating technical limits).

Costs used in the model have largely come from DESNZ, with capabilities data sourced from our work on FES where a DESNZ value was not provided.

Further details can be found in our [SSEP Methodology document](#).

For the purpose of informing advice on the optimal range of LDES for Window 1, we have reviewed interim outputs from the CEM modelling analysis to examine some credible upper and lower bounds of LDES deployment by 2035.

Across the interim CEM modelling, the majority of the outputs from modelled pathways and sensitivities indicate that the middle to upper bound of additional LDES deployment in the recommended range is more likely to be cost-optimal for GB. Volumes in the lower bound of the recommended range (below the 4.7-7.7 GW range given by the FES 2025 pathways) appear in a minority of our examined sensitivities (which didn't include exploring impacts of weather years).

At the same time, we have also identified a high sensitivity of LDES deployment to weather year assumptions. If there were no extreme weather years in the period tested, we would expect the model results to point towards the lower bound of the recommended range. For awareness, we also observe that LDES deployment continues to grow across most modelled runs beyond 2035.

These results provide a credible indication of cost-optimal LDES deployment from an advanced cost-optimisation model. However, we have not used them to revise the recommended range, as the formation of a final optimal range would require more comprehensive assessment, including robustness across a broader set of pathways and sensitivities and appropriate quality assurance. The results that will be presented within the SSEP may be different and development of the SSEP is still ongoing.

The findings are therefore presented as interim insights to support the assessment of whether the previously recommended range remains appropriate, rather than to provide a revised range.

## Additional insights in response to Ofgem questions

### What are the impacts of the wider portfolio mix on deployment of LDES?

The interim CEM modelling results are not sufficiently comprehensive to identify clear trends of how the deployment of other technologies impacts LDES. However, from the interim outputs we are seeing an initial trend emerging that higher deployment of intermittent renewables increases the need for LDES. This is the case both for solar PV and wind. LDES deployment is also comparably higher when the interim CEM modelling relies less on nascent technologies, including hydrogen to power, CCS, and nuclear SMRs but it is not possible to identify which of these is having the strongest impact. Conversely, we see an indication of lower deployment of LDES in some instances where more gas-fuelled capacity is available. These trends, while aligning with the rationale that LDES will be more valuable where supply is more variable and other flexibility is more limited, are indicative, as the interim modelling is system level and not set up to explore definitive causal relationships between single technologies.

### What are the differences in how short duration storage and LDES act on the system?

The analysis based on our interim CEM modelling demonstrates some differences in the behaviour of different duration storage assets, with an overarching trend that LDES is preferred in the interim modelling for longer duration events due to the assumed lowest cost per GWh of storage, while short duration storage is preferred for shorter duration events and operates more frequently than LDES due to the assumed lowest cost per GW. These different roles and deployment trends of different storage options reflect the relative economics of the technologies in the interim modelling assumptions (provided by DESNZ). In the interim modelling, at times when wind and solar generation are low for sustained periods, LDES is operating at the margin of the system and displacing residual unabated gas demand and hydrogen-based dispatchable generation. The assumed cost of storage options per GWh (rather than cost per GW) is a key driver of deployment choices made by the cost-optimisation model to meet system need in these circumstances.

Even though the cost and operational assumptions imply that different storage options have different roles on the system, once an asset has been built it can be more cost effective to use that asset at any duration rather than building additional storage capacity. Beyond the input assumptions and the discernible trends in our interim modelling, there may also be other real-world factors which can impact the deployment behaviour of storage assets and that our interim modelling does not incorporate.

## What is the impact of restricting LDES?

The interim CEM modelling chooses to deploy additional LDES across runs, indicating that deploying LDES within the recommended range during Window 1 is part of the least cost system that meets the constraints and assumptions underlying our analysis. Restricting LDES during the Window 1 period results in higher overall system costs, given the need to build alternative assets that are less cost-optimal to make up for the role the LDES would have played. Providing a specific quantification of the system cost impact is complex given the interconnectedness with the uptake of other energy generation technologies out to 2050. We have also observed that the system cost impact of restricting LDES deployment is highly sensitive to weather assumptions. However, further analysis<sup>2</sup> confirms that all considered low-carbon alternatives (shorter duration batteries, hydrogen-based power, gas with CCS) result in additional costs compared to LDES also in the nearer term when applying the same weather pattern assumption as that used across the interim CEM modelling.

To consider the wider impacts of restricting LDES buildout, we have explored what replaces LDES in our interim CEM modelling if deployment is restricted until 2037. We have explored two modelling runs. The first run previously had LDES deployment around the middle of the recommended range and the second run previously had LDES deployment towards the top of the recommended range.

In the first run, the strongest trend when LDES is restricted is that more gas capacity is required within the Window 1 period. When gas replaces LDES before 2037, the model adds new gas plants to the system to partly displace generation from older plants. This is likely impacted by fixed gas retirements in the model – it may be that the additional gas requirement could be achieved by retaining existing gas plant for longer. The additional use of unabated gas generation would result in increased emissions which would make emissions targets harder to meet.

The second run also sees the trend of gas plants replacing LDES. Not all the LDES deployment withheld in this model run before 2037 is replaced by gas; part of it is replaced by hydrogen-driven power plants as well as additional offshore wind deployment. This modelling run assumes a lower reliance on unabated gas.

The overarching trend that unabated gas capacity would be needed to replace LDES is also confirmed by the July 2025 update to our '[Resource Adequacy in the 2030s](#)' report, which found that additional unabated gas deployment would likely be required to maintain security of supply if additional LDES is not deployed.

These trends are based on exploring the impacts of restricting LDES under two specific scenarios. A broader range of scenarios was not feasible to run in the time available. The results need to be

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<sup>2</sup> See the dispatch modelling analysis described in the [Assessment of LDES Impacts](#)

considered in the context of the limited number of runs and the interim nature of the modelling outputs.