Electricity Capacity Report 2023

Summary version

ESO

Navigation

You can navigate this document using the prompts described to the right.

Back a page

Forward a page

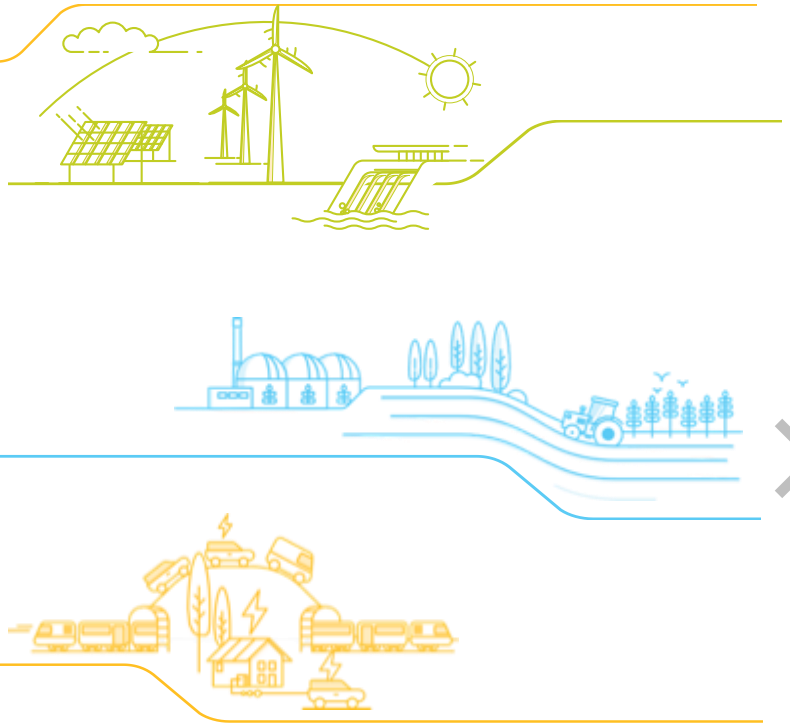
Return to contents

From here you can navigate to any part of this publication

Text Links

Click **highlighted** text to navigate to an external link or elsewhere in the document..

Contents



Introduction

The Capacity Market (CM) is Great Britain's main mechanism to ensure security of supply. The ESO, as the EMR Delivery Body, is required to provide recommendations to Government on the capacity to secure and auction de-rating factors for the forthcoming CM auctions. This Electricity Capacity Report (ECR) summary provides an overview of these recommendations, along with the scenarios and sensitivities that the recommendations are based on, and a description of our key methodologies.

Russia's illegal invasion of Ukraine continues to impact global energy markets. Our recommendations in this report assume that there continues to be sufficient available gas supply for gas-fired power generation, and that electricity interconnectors respond to market signals. We continue to monitor the impact of Russia's illegal invasion of Ukraine on both global and UK markets, working closely with Government, Ofgem and National Gas Transmission.

We recommend capacities to secure for the T-1 and T-4 CM auctions to meet the GB reliability standard of 3 hours loss of load expectation (LOLE) for a credible range of risks and uncertainties. This can lead to an outcome where the Base Case LOLE is lower than 3 hours per year.

We consider this to be appropriate and means that when we get to the Delivery Year , we will have a margin that provides sufficient resilience to credible risks and uncertainties, and means that the Reliability Standard should still be met, even if these credible risks and uncertainties materialise.

Our modelling continues to increase in complexity each year with increasing numbers of smaller and distributed generators, as well as greater volumes of renewable generation, storage and interconnectors. We have also made some significant improvements to our modelling approaches this year. This includes modelling future unknown non-delivery probabilistically in our capacity to secure simulations and improving our understanding of uncertainties in peak demand forecasting. We have also moved our interconnector de-rating factor modelling into PLEXOS, while retaining the same modelling approach.

More details can be found on our methodology and results in our main ECR report and supporting data for charts and tables in our ECR Data Workbook.

Recommendations

Capacity to secure and de-rating factor recommendations

T-1 auction for delivery in 2024/25

& T-4 auction for delivery in 2027/28

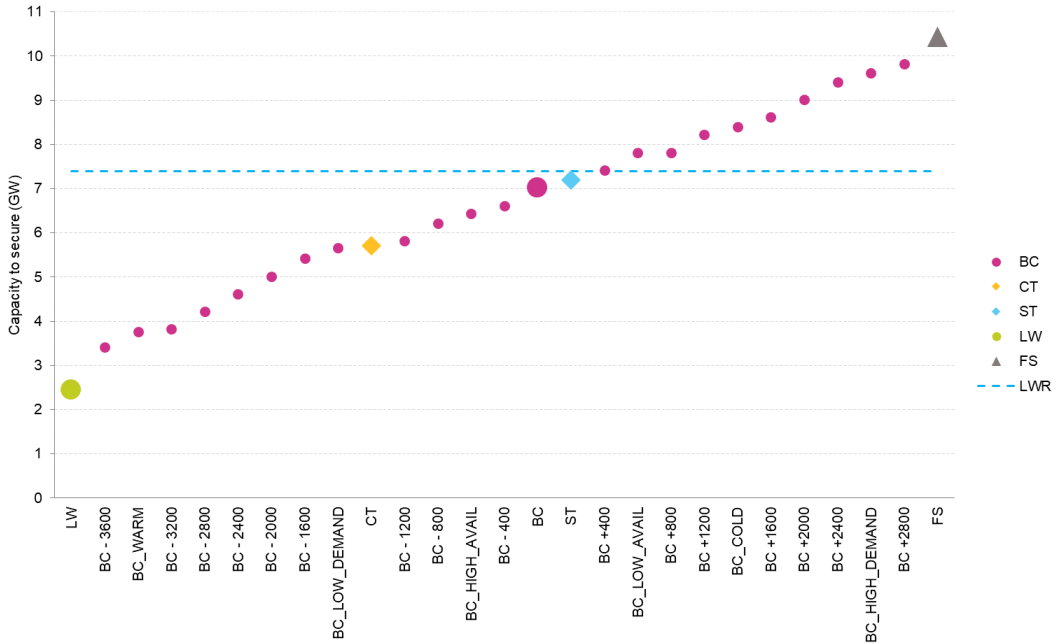
T-1 capacity to secure – LWR range

Our recommended capacity to secure for the T-1 auction for delivery in 2024/25 is **7.4 GW**.

This is our least worst regret (LWR) outcome – the cases that determine the recommended capacity to secure (Leading the Way and Falling Short) are explained in more detail in *scenarios and sensitivities*.

The Base Case, our "best view" of the next five years, has a capacity requirement that is 0.4 GW below the recommended capacity to secure (see graph to right).

For the case ahead of the 2024/25 winter where no future unknown non-delivery has yet materialised (similar to the ESO's Winter Outlook Reports), this recommendation corresponds to a Base Case LOLE of 0.3 hours and a de-rated margin of 3.8 GW (6.3%), while if the 3 GW of future unknown non-delivery were to materialise then by the 2024/25 delivery year the Base Case LOLE would be 2.4 hours



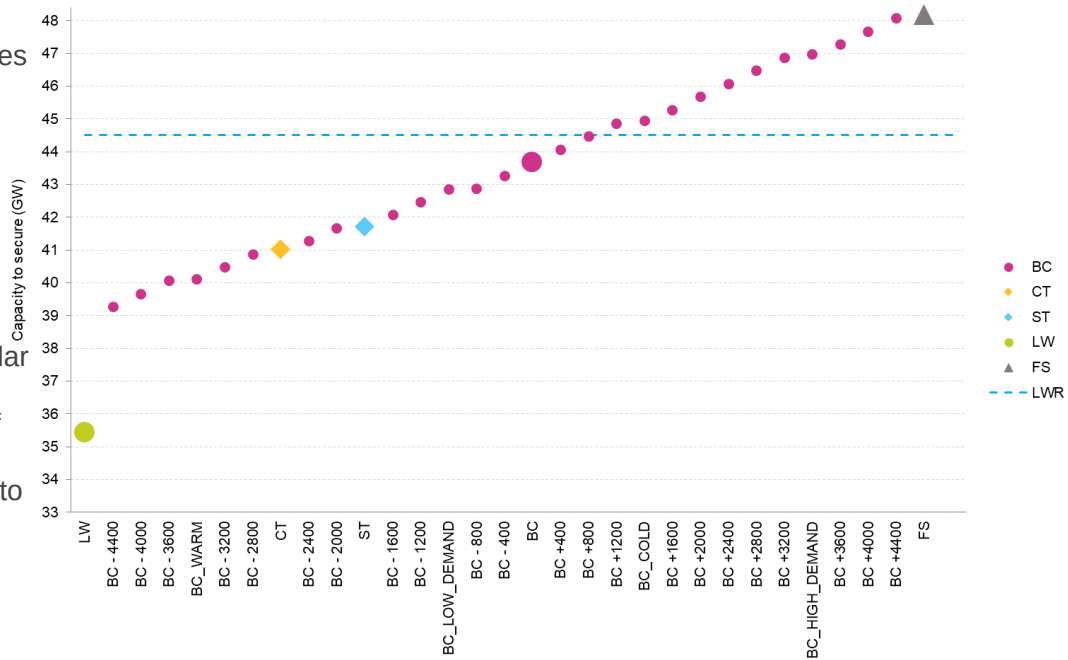
T-4 capacity to secure – LWR range

Our recommended capacity to secure for the T-4 auction for delivery in 2027/28 is **44.5 GW**.

This is our least worst regret (LWR) outcome – the cases that determine the recommended capacity to secure (Leading the Way and Falling Short) are explained in more detail in *scenarios and sensitivities*.

The Base Case, our “best view” of the next five years, has a capacity requirement that is 0.8 GW below the recommended capacity to secure (see graph to right).

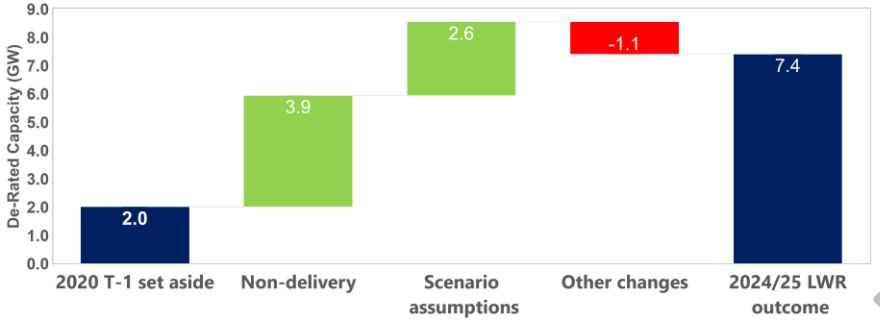
For the case ahead of the 2027/28 winter where no future unknown non-delivery has yet materialised (similar to the ESO’s Winter Outlook Reports), this recommendation corresponds to a Base Case LOLE of 0.3 hours and a de-rated margin of 4.4 GW or 7.1%, while if the 3 GW of future unknown non-delivery were to materialise then by the 2027/28 delivery year the Base Case LOLE would be 2.0 hours.



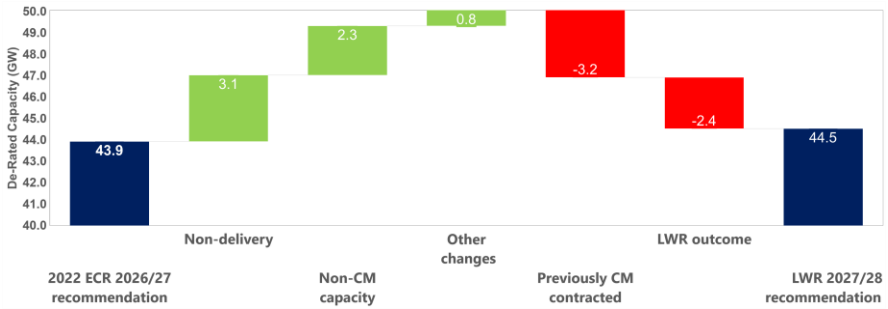
What drives our target capacity changes?

- The T-1 auction recommendation for delivery in 2024/25 comprises:
  - **Set aside** from the T-4 auction for delivery in 2024/25 by the Secretary of State (+2.0GW)
  - **Non-delivery**: known (+0.8GW) and unknown (+3.1GW)
  - **Scenario assumptions:** peak demand (+1.0GW), lower non-CM embedded capacity (+0.9GW), reserve and response (+0.7GW)
  - **Other:** 1.1GW net decrease (see main ECR for details) inc. higher auction procurement for low clearing price (-0.7GW)
- The recommended T-4 auction capacity for delivery in 2027/28 is slightly higher than the T-4 auction for delivery in 2026/27 due to:
  - **Non-delivery:** unknown (+3.1GW)
  - **Lower RO/CfD capacity**: mainly due to end of support for biomass conversion (+2.3GW)
  - **Other:** 0.8GW net decrease (see main ECR for details)
  - **Contracted CM:** mostly CCGT and storage (-3.2GW)
  - **LWR outcome change** (-2.4GW)

T-1 auction for delivery in 2024/25



T-4 auction for delivery in 2027/28



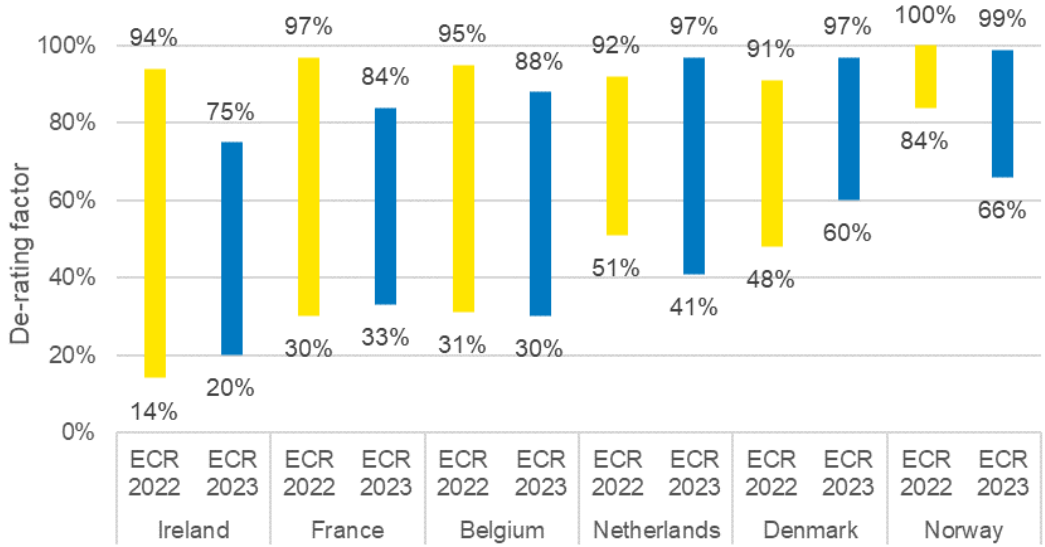
Interconnected countries de-rating factors

Our recommended ranges of de-rating factors for interconnected countries are shown in the graph to the right. Ultimately the final de-rating for each country is a decision for the Secretary of State.

These de-rating factor ranges apply to the T-4 auction for delivery in 2027/28, as all other interconnectors have secured an agreement for 2024/25.

The modelling approach used this year is the same as last year, however we are now using Energy Exemplar's PLEXOS as our Pan-European market modelling software instead of AFRY's BID3. Energy Exemplar have also worked in partnership with Baringa to supply our European scenarios and historical weather data. Our interconnector de-rating factor briefing note provides details on the methodology used this year.

Further details on the sensitivities that set the de-rating factor ranges, as well as explanations on differences between the 2022 and 2023 ECRs, can be found in chapter 5 of our longer form report.



Interconnected countries de-rating factors

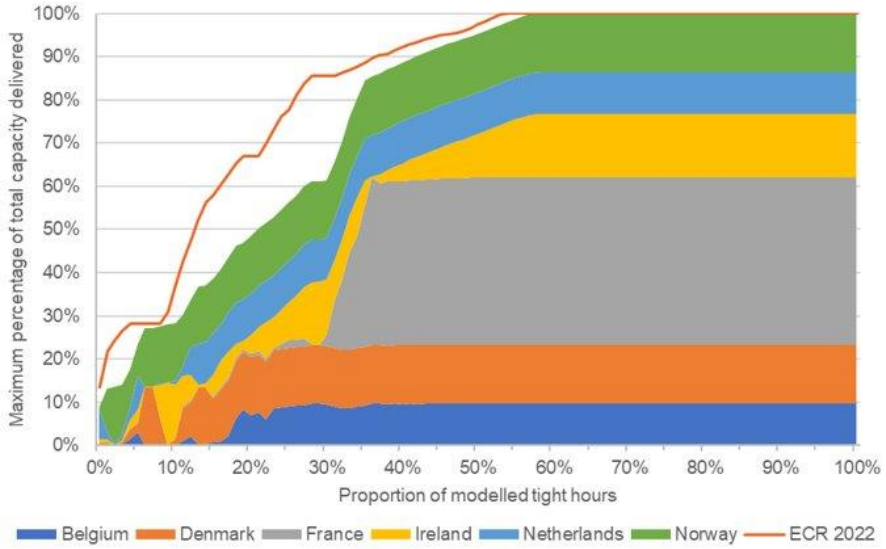
We also continue to provide insight on the total available interconnected capacity across the interconnector fleet.

The nature of economic arbitrage is to produce a bimodal distribution of interconnector flows from individual markets i.e. exports from those markets are either nil or close to 100%. Correlations in peak demand or capacity between neighbouring European markets can create periods when the unavailability of interconnected capacity is compounded.

The graph opposite shows the maximum percentage of fleet capacity expected for a given proportion of all modelled hours in our Base Case.

France plays the biggest role in shaping this curve as it provides the largest total capacity and has tight periods that are extremely highly correlated with Great Britain. This can be seen by the fact that it provides very little capacity in the first 30% of tightest hours in our modelling.

See chapter 5 of the main report for more insight on the fleet contribution.



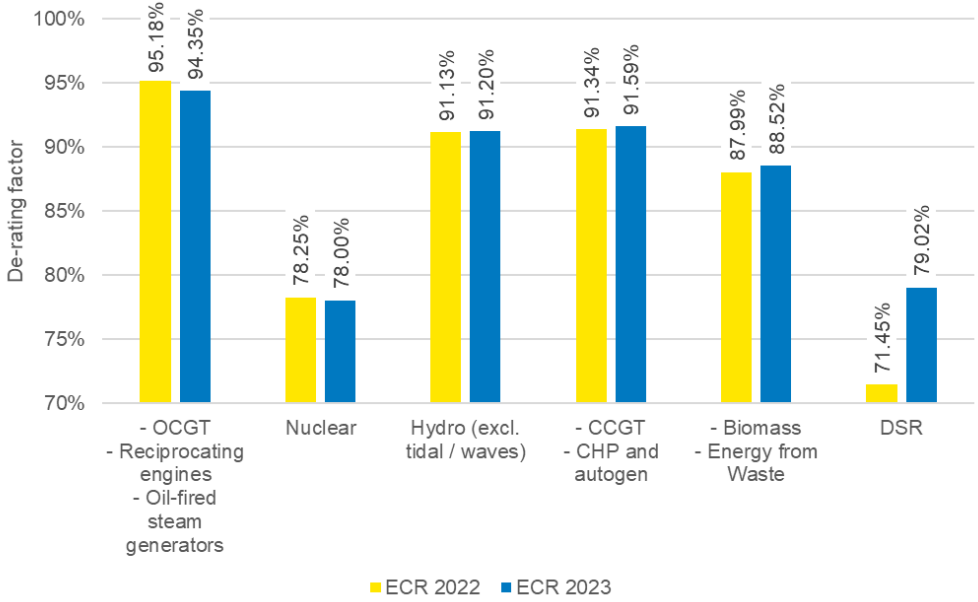
Conventional plant & DSR de-rating factors

The graph to the right shows our recommended conventional plant and demand-side response (DSR) de-rating factors.

DSR de-ratings have increased this year with finalisation of the move of non-BM STOR to day-ahead procurement from seasonal contracts.

The methodology for conventional plant de-rating factors is prescribed in the capacity market rules - we take the average availability (MEL) during the winter peak period (0700-1900, Monday-Friday, December-February) at times with demand above the 50th percentile (all plant except CCGT, CHP and autogen) or 90th percentile (CCGT and autogen) over the last 7 years.

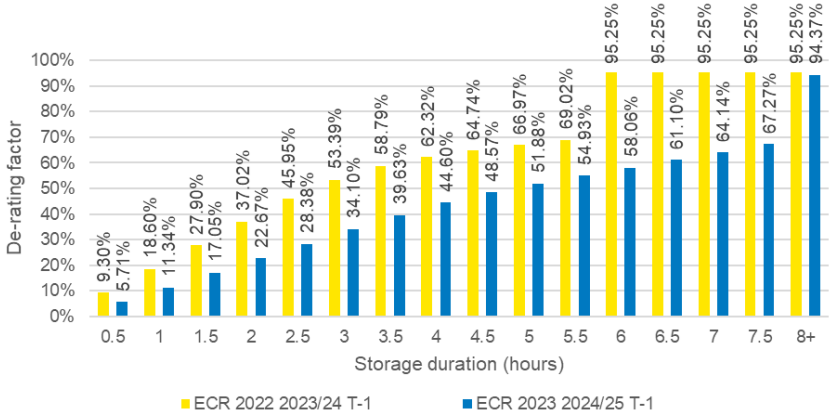
The methodology for DSR de-rating factors uses the mean committed STOR availability of Non-BM STOR providers over the last three winters during winter peak period (0700-1900, Monday-Friday, December-February) at times with demand above the 50th percentile.



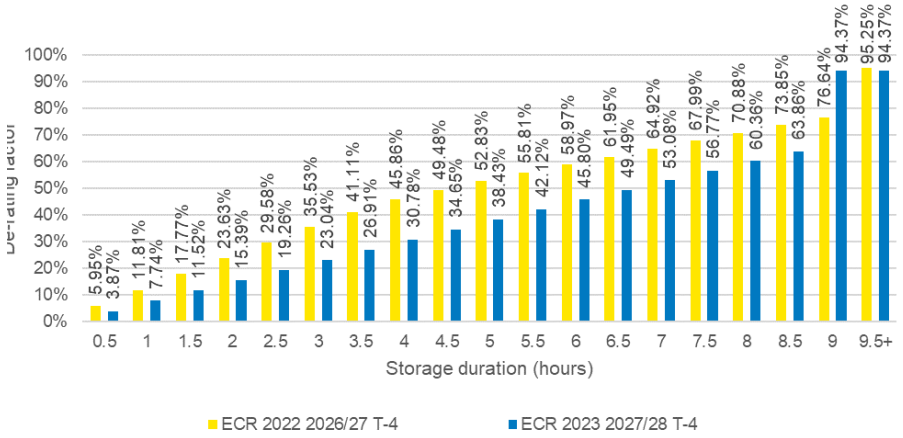
Storage de-rating factors

There is a general downward trend in storage de-rating factors compared to the 2022 ECR, reflecting a significant increase in CM contracted storage capacity for the target years. The Duration Limited threshold has also increased from 6 hours to 8 hours for the T-1 auction and slightly decreased from 9.5 hours to 9 hours in the T-4 auction compared to the 2022 ECR Further details on our storage de-rating factor methodology can be found in our storage and renewables de-rating factor briefing note. The numerical values can be found in our ECR Data Workbook.

T-1 auction for delivery in 2024/25



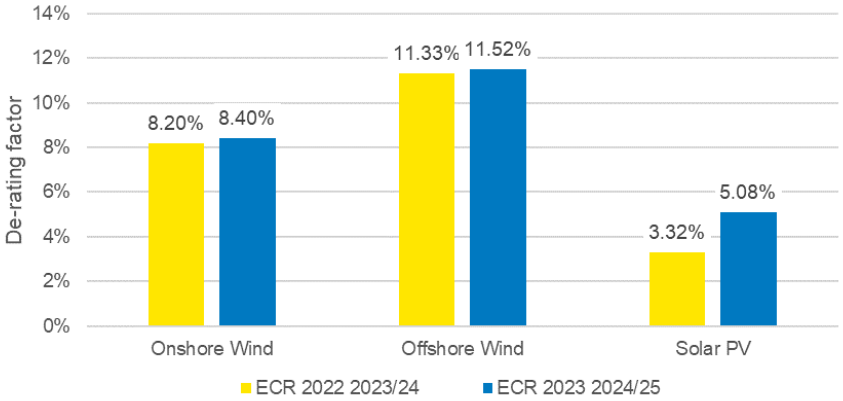
T-4 auction for delivery in 2027/28



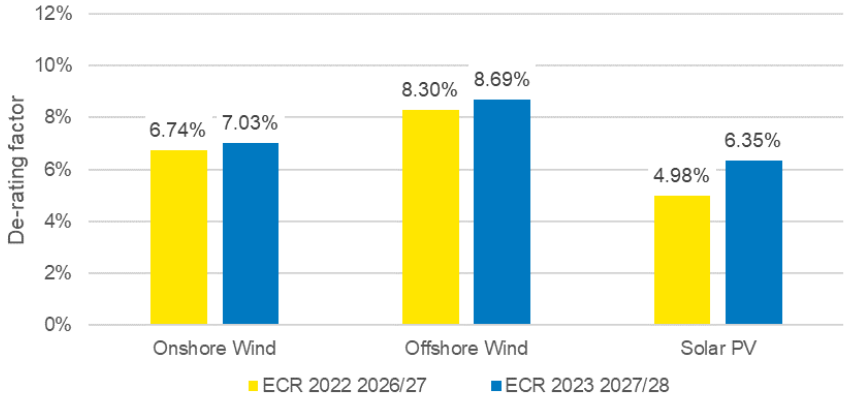
Renewables de-rating factors

There is a small increase in onshore wind and offshore wind de-rating factors and a larger increase in solar PV de-rating factors compared to the 2022 ECR. The latter is due to increased CM contracted short-duration storage capacity which shifts the distribution of stress events towards longer events that start earlier in the day (when there is some solar output) in a system at 3 hours LOLE. Further details on our renewables de-rating factor methodology can be found in our storage and renewables de-rating factor briefing note. The numerical values can be found in our ECR Data Workbook.

T-1 auction for delivery in 2024/25



T-4 auction for delivery in 2027/28



Scenarios and sensitivities

Future energy scenarios (FES) and modelled sensitivities

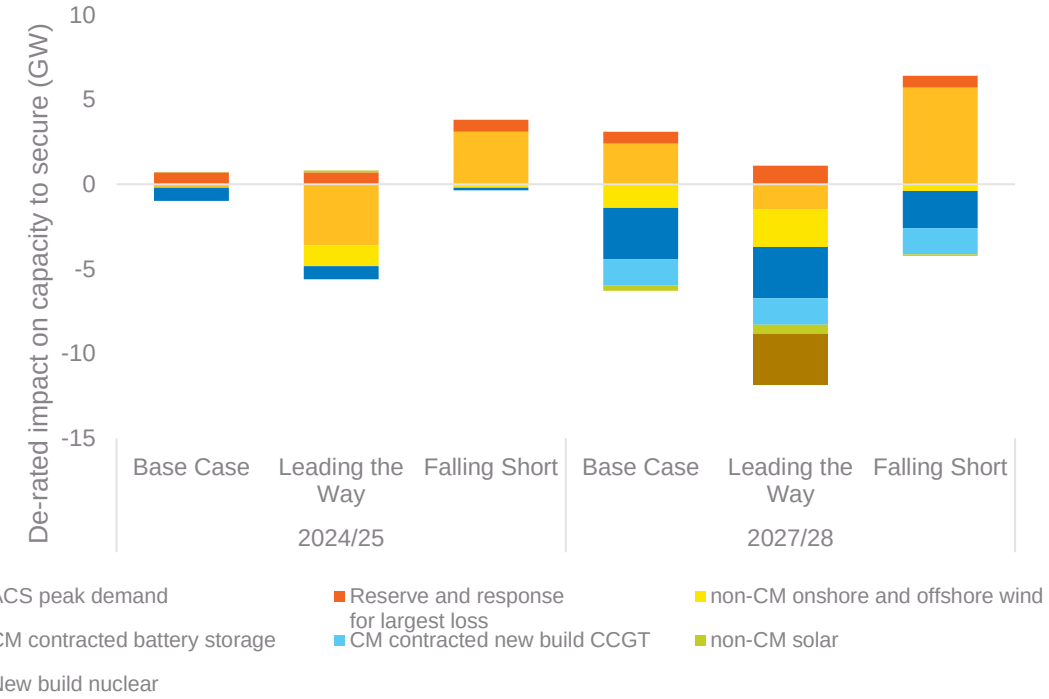
ESO

Base Case and scenarios changes

The ESO's Future Energy Scenarios provide the majority of the input data for our capacity to secure and de-rating factor modelling. The graph to the right shows the **de-rated impact on the capacity to secure** of Base Case, Leading the Way and Falling Short changes between the most recent winter (2022/23) and the target years in the auction.

The Base Case reflects our best view of demand and generation over the next five years, while Leading the Way and Falling Short are our highest and lowest speed of decarbonisation and level of societal change, respectively. Leading the Way and Falling Short are the lower and upper bound of our LWR calculation this year for both the T-1 and T-4 recommendations.

For simplicity, the graph only shows the changes that are material to the capacity to secure modelling. **Supply increases are shown as a negative impact** on the capacity to secure.



Note: modelled non-delivery and biomass conversion end of RO/CfD support not shown

Modelled sensitivities

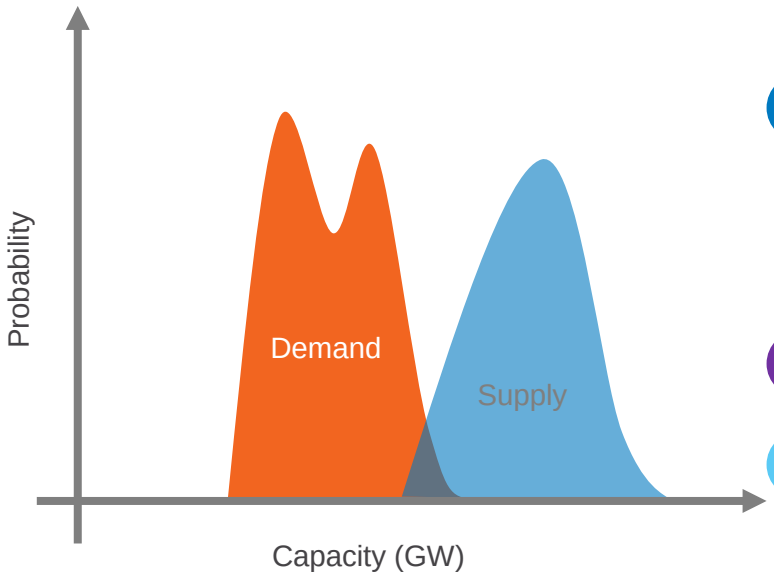
The below table describes the modelled sensitivities to the Base Case in the 2023 ECR. Note that this year, we modelled future unknown non-delivery via a non-delivery probability in all scenarios and sensitivities. To avoid double-counting of unknown non-delivery, this means that the non-delivery sensitivities were only used to provide 0.4GW increments of procured capacity above the Base Case and were **not allowed to set the LWR outcome**. The other sensitivities could have set the LWR outcome but results did not in fact do so.

Sensitivity	Description	Values
Non-delivery	Represents capacity with CM agreements that fail to deliver against their obligations for the entire winter. Not allowed to set the LWR outcome.	4.0 GW for T-1 (on top of average non-delivery) 4.4 GW for T-4 (on top of average non-delivery) Modelled in steps of 0.4 GW
Over-delivery	Represents capacity providers delivering above Base Case obligations for the entire winter. Several observations of stations staying open without CM agreements leading to over-delivery	3.6 GW for T-1 (with average non-delivery) 4.4 GW for T-4 (with average non-delivery) Modelled in steps of 0.4 GW
Cold / warm winter	Cold winter and warm winter modelled via demand from a historical year with associated wind output.	Cold winter: 2010/11 Warm winter: 2006/07
High / low demand	Represents the uncertainty in forecasting peak demand (particularly metered demand, losses and sector demand) via Monte Carlo outputs.	High demand: 90th percentile (see Table 4 of report) Low demand: 10th percentile (see Table 4 of report)
High / low availability	Represents the uncertainty in power station reliability. See Table 3 of the main ECR report for availability values. Used for T-1 Only.	High avail: mean plus 1 s.d. (CCGT only) Low avail: mean minus 1 s.d. (CCGT / nuclear)

Approach and methodologies

Overview of the methodologies that underpin our recommendations

Time collapsed calculation



1

Demand: 16 years (2005-2021) of historical hourly transmission demand, with an estimate of embedded wind and solar. Scaled by ratio of FES forecast average cold spell (ACS) peak demand to historical year ACS peak demand.

2

Supply: 16 years (2005-2021) of historical embedded wind and solar estimates from NASA reanalysis wind speed and solar irradiance data. Wind adjusted based on correlation with peak demand. Conventional generation capacity multiplied by technical availability. Interconnector flows based on net system margin. The supply distribution is also adjusted by an average non-delivery probability for Capacity Market (CM) capacity based on historical non-delivery.

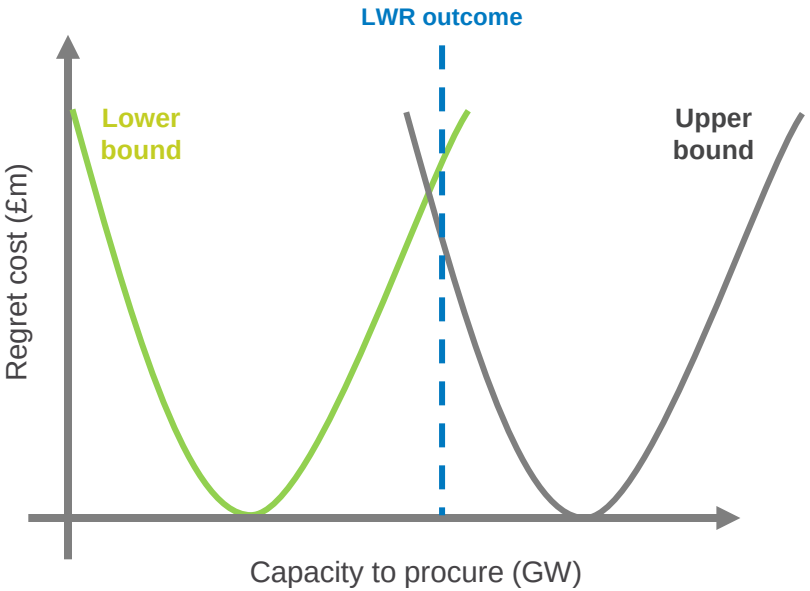
3

LOLE: LOLE calculated based on average number of hours per year where demand exceeds supply.

4

Capacity to secure: start with a supply distribution consisting of units with existing CM contracts and capacity with other subsidies such as renewables obligation (RO) and contract for difference (CfD), estimated from FES. Progressively add de-rated CM-eligible capacity to the supply stack until the LOLE = 3 hours per year which is the GB Reliability Standard. The de-rated capacity to secure is the de-rated value of all the CM-eligible capacity added (interpolated if necessary).

Least worst regret (LWR) approach



Bounds of the LWR: the LWR outcome is typically determined by the intersection (currently to the nearest 0.4GW) of the highest procured capacity scenario or sensitivity (the "upper bound") and lowest procured capacity scenario or sensitivity (the "lower bound").

1

Estimate cost of lost load: using the value of lost load, set by Government, currently £17,000/MWh per a London Economics study, multiplied by the expected energy unserved (EEU) calculated from the supply/demand distributions on the last slide.

2

Estimate cost of procuring capacity: using the cost of new entry (CONE) set by Government, currently £49/kW-year based on a new OCGT, multiplied by the de-rated capacity to secure.

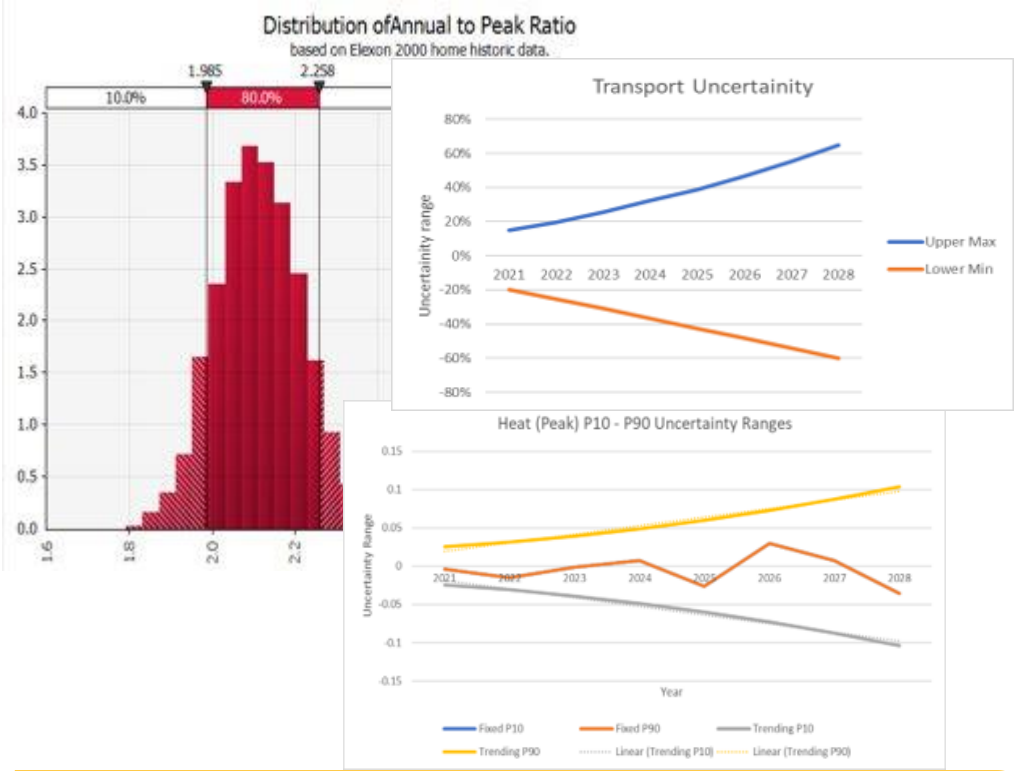
3

Construct regret cost curves: for each scenario and sensitivity, find the total cost associated with each procured capacity amount (in intervals of 0.4GW) by combining the cost of lost load with the cost of procuring capacity. The regret cost is then given by the absolute value of the difference between the total cost for the procured capacity and the total cost for the recommended capacity to secure in that scenario or sensitivity. See **figure to the left** for two example regret cost curves – note that where the capacity to procure is equal to the recommended capacity to secure in that scenario or sensitivity, the regret cost curve's value is zero.

4

Least worst regret (LWR): find the amount of procured capacity (currently in 0.4GW increments) where the highest ("worst") regret cost of all scenarios and sensitivities included is lowest ("least"). This provides the LWR outcome which is the recommended capacity to procure.

Peak demand forecast uncertainty



For the 2022 ECR we produced an interval where there is an 80% probability that the actual demand will fall within a range (P10 to P90) based on uncertainties in metered demand and losses. This year, we have improved this interval by adding sector uncertainty from transport, industrial & commercial, heat, appliances and lighting.

We have done this by eliciting from sector model experts the individual sector uncertainties over time (see graphs for heat and transport to right) based on historical sector data. We have then run a Monte Carlo model with 1500 iterations with different permutations of peak ratios, losses, and sector peak demand.

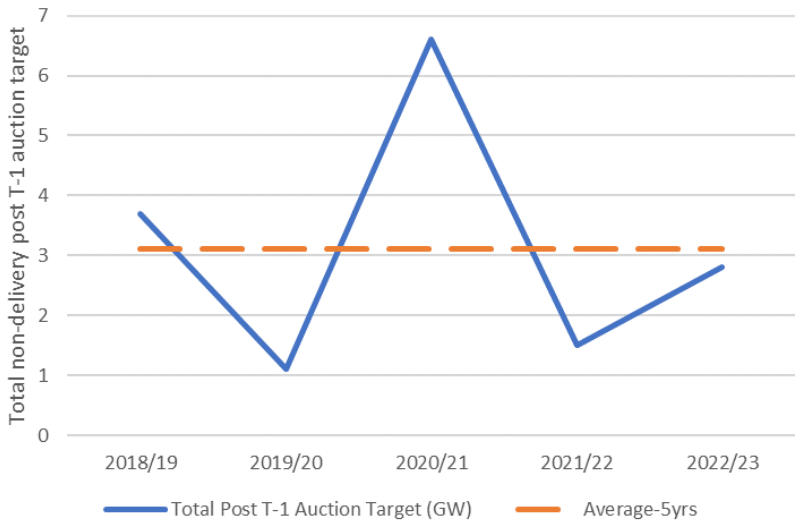
The P10 and P90 values are then used in our low demand and high demand sensitivities for our capacity to secure calculation.

Modelling future unknown non-delivery

In their 2021 report, the PTE recommended (No. 60) a review of our approach to modelling future (unknown) non-delivery risks in the ECR. In Phase 1 of this project, our academic consultants recommended that we should model modest levels of future non-delivery (similar to an average of historical levels) by multiplying the station availabilities currently used in the LOLE calculation by (1 – an average non-delivery probability).

In Phase 2 of the project carried out for the 2023 ECR, we have updated our view of historic non-delivery and when it became known to us (see figure to right) and commissioned LCP Delta to implement the recommendation to model non-delivery probabilistically in the DDM. We have also tested the impacts of those changes on the capacity to secure modelling for the 2022 ECR Base Case for different non-delivery probabilities using the new DDM functionality.

Based on our testing, we have decided to utilise this new functionality in the 2023 ECR by applying a 6% average non-delivery probability to CM-eligible capacity (except wind and interconnection) in all DDM runs which gives an increase in the capacity to secure to meet 3 hours LOLE of around 3 GW. This increase is similar to the average non-delivery in the most recent 5 delivery years that occurred after the final T-1 target had been set following prequalification.



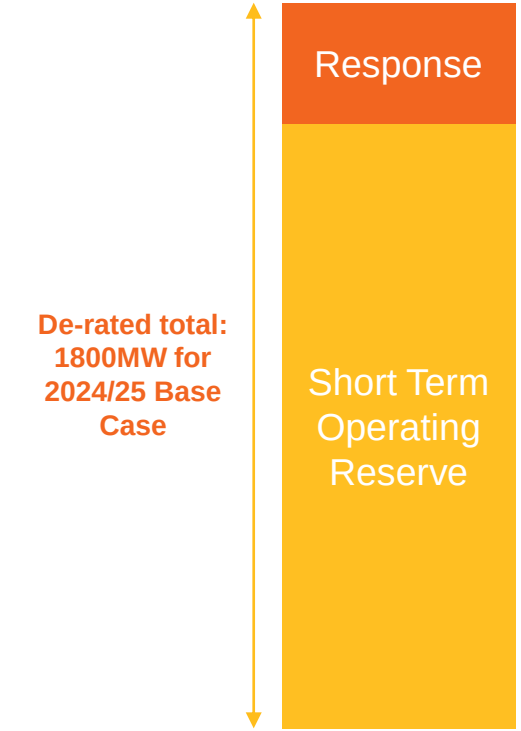
Reserve and response for largest loss

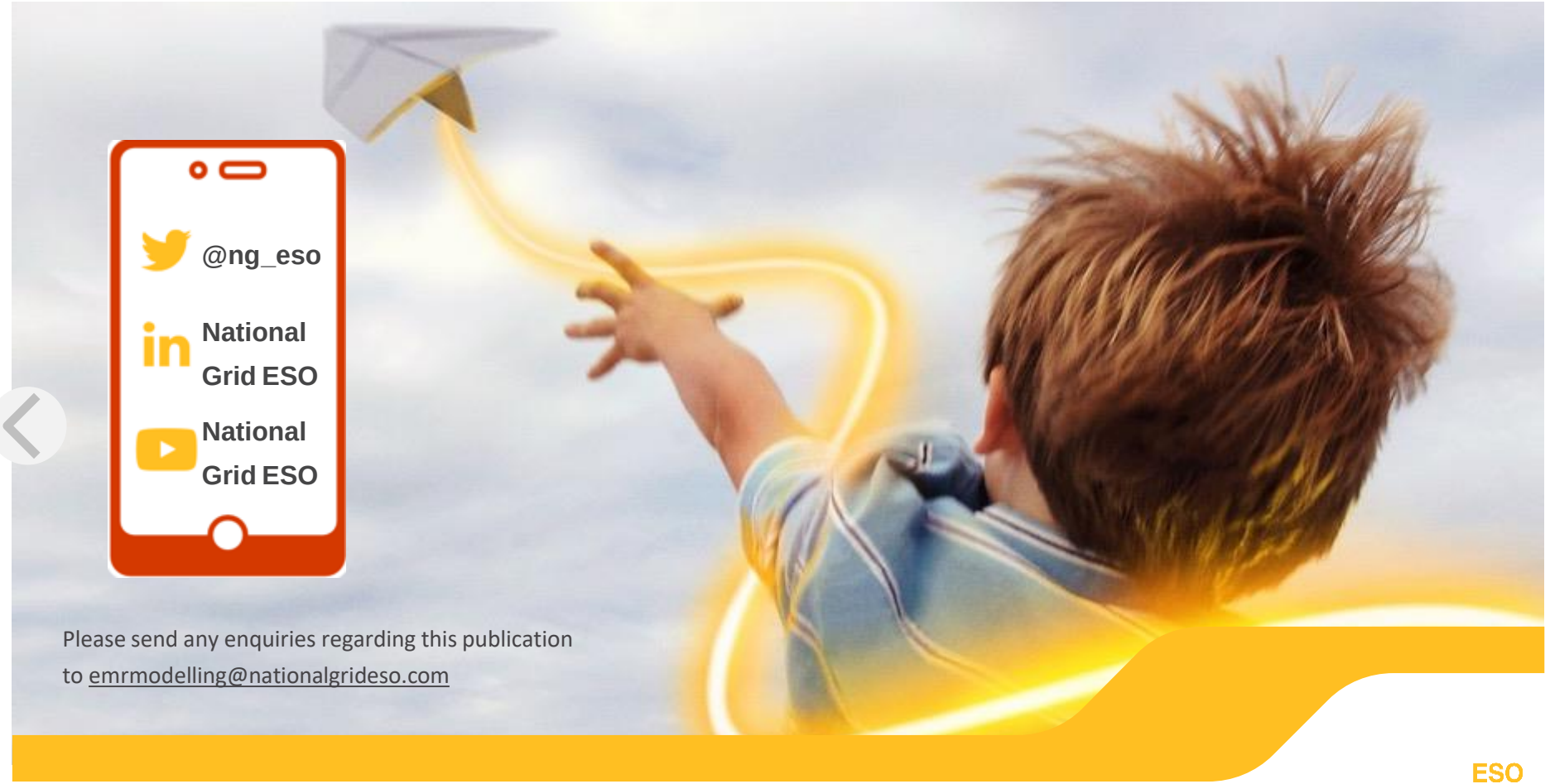
We account for ancillary services in our capacity to secure recommendation via the reserve and response quantities held for the loss of the largest single unit (for example, a generator or interconnector) expected in the target year for each auction. The ESO is required to plan, develop and operate the system in accordance with the security and quality of supply (SQSS) standard which includes provisions for frequency deviations after the loss of any single generating unit. Therefore we add the de-rated reserve and response values to the demand distribution in our capacity to secure calculation.

This year, in response to a Panel of Technical Experts (PTE) 2022 report recommendation, we have aligned the services and volumes in our reserve and response for largest loss calculation with our expected procurement approaches, which have seen some significant development over the last few years with response and reserve reform initiatives.

The figure to the left shows an example of our updated approach for our Base Case in the 2024/25 delivery year. Note that the reserve and response quantities are de-rated based on the average technology provider. This means that response uses a lower de-rating factor as most response services including Dynamic Containment are provided by shorter duration battery storage.

These estimates are based on current procurement approaches; as this is a rapidly changing area, we will continue to review expected services and volumes as necessary.





Please send any enquiries regarding this publication to emrmodelling@nationalgrideso.com