Panel of Technical Experts

Report on the National Grid ESO Electricity Capacity Report 2023

July 2023

Contents

Preliminary Comments & Summary of Recommendations

1. The role of the Panel of Technical Experts ("PTE") is to scrutinise with impartiality and to contribute to the quality assurance of the annual Electricity Capacity Reports by National Grid ESO. The purpose is to provide technical advice to inform the policy decisions at the Department for Energy Security and Net Zero for the subsequent Capacity Market auction procurements, through this report and informal consultations.

2. In April and May 2023, the PTE were presented with the initial results from the modelling for the 2023 ECR. In response to comments from PTE and the Department for Energy Security and Net Zero the final Report was prepared by National Grid ESO and sent to the Department for Energy Security and Net Zero on 31 May 2023.

3. The PTE members who prepared this report are Professor Derek Bunn (Chair), Dr Guy Doyle and Professor Frank Kelly.

4. In fulfilment of our role, we have scrutinised National Grid ESO's 2023 Electricity Capacity Report on the target capacity for the proposed T-1 Auction for delivery year 2024/25 and the T-4 Auction for the period(s) commencing 2027/28, and this document presents our conclusions.

5. Through our previous reports (2014-2022), the PTE has made 73 recommendations in total (of which 8 were from 2022) for improving the methodology and reliability of the modelling by which target capacities are calculated. National Grid ESO has taken actions on most of these as reported in the ECR. As usual, we make some recommendations for future work. In doing so the PTE are mindful of the need for the appropriate processes and procedures to be followed ahead of any changes that may be undertaken.

6. The PTE has engaged in relevant discussions with National Grid ESO, the Department for Energy Security and Net Zero and Ofgem during the process of National Grid ESO formulating the Electricity Capacity Report 2023. We are satisfied with the constructive and timely consultations and believe that all parties have worked well together in formulating the analysis and recommendations.

7. The overall analytical approach has been similar to previous years, updated with new information, an evolution in some of the analytics and implemented with a new software provider. We have been provided with the modelling documentation and assumptions required for our scrutiny.

8. We agreed on the sensitivities that went into the estimation and their application in the 'Least-Worst Regret' criterion to determine the capacities to procure.

9. We have considered the target capacity recommendations by National Grid ESO and make the following recommendations:

- For T-1, we accept the recommendation of 7.4 GW in the ECR. We recognise that this gives a similar de-rated margin to the previous year's procurement. The energy security circumstances in 2022 led to a high level of risk aversion. Whilst the management of those supply risks may now be clearer, we accept that the level of risk in the outlook remains unusually high.
- For T-4, we accept the 44.5 GW recommendation in the ECR. As with previous years, we recommend a detailed reconsideration of the supply-side of the base case and the non-delivery sensitivities in the autumn.

10. Without having direct evidence to suggest reductions to these targets, the PTE is concerned about potential over procurement and the consequent costs to society. We anticipate that more information will become available in time for any autumn adjustments and suggest that a careful re-evaluation of the supply-side of the base case and the interconnector risks be undertaken at that time. At the time of writing, the geopolitical concerns for gas supplies to Europe remain considerable and we note they were not taken into account in the ECR. How the geopolitical situation may evolve in the short term is highly speculative and we agree that there is not strong evidence to change the fundamental assumptions at this point, notwithstanding the need to maintain an appropriate risk aversion in the analysis.

11. We summarise our recommendations for interconnector de-rating factors below. Despite updated assumptions and some new modelling, we are not persuaded there is strong evidence to substantially change the assessments from last year. Nevertheless, in this context, we are becoming increasingly concerned about the systematic risk posed by the correlations and bimodal distributions of potential interconnector flows at times of stress events.

PTE Recommended Country De-rating Factors for 2027/28 (with 2026/27 included for reference**)**		
	2026/27	**2027/28**
Ireland	55%	55%
France	70%	65%
Belgium	65%	65%
The Netherlands	62%	62%
Denmark	60%	60%
Norway	91%	91%

12. Overall, we were very pleased with the open and constructive process of engagement with National Grid ESO and the Department for Energy Security and Net Zero. We thank them for their extensive efforts to develop clear and timely analysis and address many of the technical issues which we have raised. We have also taken note of various industry

comments invited by National Grid ESO on the approach to interconnector derating estimation.

Recommendations

13. The new recommendations in our report are listed below. The numbering follows on from the 73 Recommendations in previous PTE reports.

Recommendation 74: National Grid ESO to review and clarify how the extreme FES scenarios can be quality assessed as predictors of ranges for the short-term forecasts and how, or if, they should be used alongside the estimated probability distributions around the Base Case.

Recommendation 75: National Grid ESO to monitor the change, if any, in demand responses to peak periods as a result of the Triad disappearance.

Recommendation 76: National Grid ESO to consider how over-delivery can be brought into the general stochastic methodology alongside the progress already achieved with non-delivery and demand.

Recommendation 77: National Grid ESO to consider the use of operational data for estimating wind derating factors with explicit reference to the weather-induced correlations between demand and supply and the calibration of wind power functions.

Recommendation 78: National Grid ESO to explore further the risk arising from correlated weather patterns across Europe. In particular, to continue the statistical analysis of ICDRFs to understand the implication of weather correlations on the aggregate risk of GB interconnections at times of stress and to consider potential new risk measures that go beyond simple averages in order to better represent the risks from bimodal and correlated flows.

Recommendation 79: National Grid ESO to present a vision of the procurement decision analysis framework as the methodology evolves away from LWR to a fully stochastic risk simulation.

Recommendation 80: National Grid ESO to provide some methodological suggestions on a more future-contingent approach to T-4 procurement in order to take account of the prospect of emerging disruptions in the energy transition.

Recommendation 81: National Grid ESO and the Department of Energy Security and Net Zero to consider whether T-1 and T-4 remain the optimal target years for resource adequacy procurements.

Introduction

Role of the Panel of Technical Experts

14. The Government commissioned, through an open and transparent procurement process, an independent Panel of Technical Experts (the PTE) for the enduring Electricity Market Reform (EMR) regime, commencing in February 2014. The role of the Panel of Technical Experts ("PTE") is to scrutinise with impartiality and to contribute to the quality assurance of the annual Electricity Capacity Reports by National Grid ESO, in its role as Delivery Body for the Capacity Market. The purpose is to provide technical advice to inform the policy decisions at the Department of Energy Security and Net Zero for the subsequent Capacity Market auction procurements.

15. The PTE's first report on National Grid's analysis to inform Capacity Market decisions was published in June 2014. This is the PTE's tenth report, focused on the modelling and results of National Grid ESO's recommended capacity to secure for the 2027/28 T-4 auction and for the 2024/25 T-1 auction.

16. The background of the members and terms of reference of the PTE are published on the Government website.[1]

17. This report has been prepared for the Department of Energy Security and Net Zero by Professor Derek Bunn (Chair), Dr Guy Doyle and Professor Frank Kelly.

Scope

18. The scope of the PTE's work is to impartially scrutinise and quality assure the analysis carried out by National Grid ESO for the purposes of informing the policy decisions for the Capacity Market procurement. This includes scrutinising: the choice of models and modelling techniques employed; the inputs to that analysis (including the ones the Department for Energy Security and Net Zero provides); and the outputs from that analysis - scrutinised in terms of the inputs and methods applied. The PTE review whether the analysis is robust and fit for the purpose of Government taking key policy decisions. This includes, for example, considering potential conflicts of interest National Grid ESO or others involved might have in influencing the analysis.

19. The PTE has no remit to comment on the Capacity Market mechanism design, its regulation or wider EMR policy, Government's objectives, or the deliverability of those objectives, unless otherwise requested. The PTE's Terms of Reference mean it cannot comment on affordability, value for money or achieving least cost for consumers. These matters are excluded from the PTE's scope and therefore from this report. Nevertheless, the PTE is mindful of the need to avoid the costs to consumers of over-procurement. The role of the Panel is a technical function and not a forum for policy commentary or for

[1] https://www.gov.uk/government/groups/electricity-market-reform-panel-of-technical-experts

advising the Government on its objectives, the policies being implemented or policy decisions surrounding them. This means the Panel does not have a role in advising how the analysis should be interpreted for the purpose of those policy decisions, but have commented where these impact the modelling and parameter setting in the ECR.

Process

20. During the course of the PTE's work, National Grid ESO has presented its methods, assumptions and outputs in relation to their core task of recommending the auction target capacity in the Capacity Market and the PTE has had opportunity to question National Grid ESO during the development of its analysis and recommendations.

21. To carry out its work, the PTE met with National Grid ESO, the Department of Energy Security and Net Zero and Ofgem regularly during April and May 2023 to discuss development projects, the production plan and modelling outputs for ECR 2023. Subsequently, the PTE provided interim views to the Department of Energy Security and Net Zero before presenting preliminary drafts of this report for further considerations and feedback from the Department of Energy Security and Net Zero Ofgem and National Grid ESO.

22. The PTE has generally focussed more closely on the areas that appeared to be of highest impact and greatest uncertainty. Key areas that emerged included:

    - Demand evolution
    - Non-delivery estimation and aggregation
    - Interconnector de-rating

23. As required by the PTE's Terms of Reference, the PTE also kept in mind the potential for National Grid ESO to be confronted by potential conflicts of interest. The PTE, throughout this process, has sought to mitigate this by carefully challenging assumptions and throughout the process the PTE has maintained a presumption that a natural tendency for any utility or TSO would be to slightly over-secure resources. We note that National Grid ESO would bear some of the loss of reputation for any blackouts, and bears none of the costs of over-procurement, and so could be expected to weight the possible risks of procuring less capacity more than they might credit the cost-savings. The PTE, however, has no evidence that would make us believe that National Grid ESO has substantially exploited its privileged position and hence there has been no conflict of interest concern up to the time of writing this report.

24. This report is not comprehensive nor is it a due diligence exercise, but the PTE believes that it has nevertheless identified some important issues that have material consequences. Accordingly, and in line with our approach in previous years, the PTE has not remarked on details of various matters which were raised and satisfactorily resolved or are part of on-going development.

25. This report has been prepared from information provided by the Department of Energy Security and Net Zero, National Grid ESO and Ofgem and the collective judgement and information of its authors. We have also taken account of several written stakeholder responses to the interconnector derating material made public by National Grid ESO. Whilst this report has been prepared in good faith and with reasonable care, the authors expressly advise that no reliance should be placed on this report for the purpose of any investment decision and accordingly, no representation of warranty, expressed or implied, is or will be made in relation to it by its authors and nor will the authors accept any liability whatsoever for such reliance on any statement made herein. Each person considering an investment must make their own independent assessment having made whatever investigation that person or organisation deems necessary.

Commentary on Analysis and Results

Introduction and context

26. As in its previous ECRs, National Grid ESO lays out its modelling approach and its scenarios and sensitivities that frame its findings on the amount of capacity to secure in the auctions to meet the Government's 3 hours Loss of Load Expectation (LOLE). Whilst the 3 hours LOLE has been the expressed target, in practice it has been interpreted as 3 hours LOLE under a cautious ("Least Worst Regret", LWR) consideration over a range of sensitivities and scenario conditions. This means that the unconditional LOLE in recent years has been much less than 3 hours. Given the difficulty of communicating the LOLE target, we find it very useful to see in the ECR that the recommendations indicate how the anticipated de-rated margins compare to previous years.

27. The major elements in the analysis are domestic Demand and Generation, together with an increasing reliance upon Interconnection resources from neighbouring countries. The de-rating factors are crucial, and we assess whether the overall methodology is fit-for-purpose. We therefore organise this section according to these main elements.

Domestic Demand and Supply

28. The peak demand is the natural starting point for the ECR, and the methodology undertaken by National Grid ESO followed the same principles as in previous years. The details however are steadily being refined and improved, with ESO introducing an element of probabilistic assessment into its demand forecasting in this year's ECR.

29. In response to Recommendation 66 in the 2022 PTE report, we are pleased that the ESO has developed its approach in assessing the uncertainty around the Base Case peak demand. It has done this by including sector level uncertainties into its Monte Carlo model of losses and metered demand. Specifically, this has led to the estimation of probability distributions for the heat, transport, industrial & commercial peak demands. These are then fed into a Monte Carlo model to develop sector and total demand uncertainties. The PTE believes that this represents a positive step and one that can be built upon in the coming years, by extending to all sectors.

30. We note, however, that the results for the P10 and P90 quantiles estimated to provide the range between low and high risks around the demand base case was 3.8 GW in T-1, which is significantly less than the range in demand levels between the two "extreme" FES cases, which is about 7 GW for the same period (winter 2024/25). The implication of this is that the two "extreme" demand FES cases stand very far outside of the 90% confidence band for prediction. Evidently further clarification would be important and perhaps further work is needed to provide a consistent view of the range of uncertainties. We are aware that the stochastic simulation results are currently incomplete in modelling all of the factors and thus underestimate the full range of uncertainties. We also suggest that perhaps P5 and P95

may be more appropriate quantiles to compare with the extreme FES scenarios. Whilst both of these aspects should improve the consistency in modelling, we also suggest that the assessment of uncertainty should also be consistent with empirical evidence related to forecast accuracy. We note that Figure 42 compares the ACS restricted demand out-turns with the winter ahead forecasts. However, these have shorter lead-times than the T-1 forecasting exercise. An empirical examination of the *ex ante* T-1 unrestricted demand forecasts with their *ex post* estimates could also begin to inform the range of uncertainties now that there are several years of historical out-turns available from the capacity markets.

31. We understand that the FES scenarios were conceived as a way of testing the robustness of ESO's planning and procurement decisions in a world of considerable uncertainty regarding the mix of economic conditions, markets, government policy, consumer behaviour and technology, but our view is the extreme FES cases may be too far outside reasonable confidence bands to be used for a short-term procurement. Given the LWR process is designed to be applied to non-extreme cases, this raises the question as to whether the extreme FES scenarios should be used in the T-1 and T-4 assessments. ESO recognises this situation and has reported to us that this reflects the transition to a more probabilistic process. As it turns out, for the LWR analysis this year, this concern is not material insofar as excluding the two FES extreme scenarios would not have a significant effect of the procurement outcome of the LWR – they would broadly cancel each other out. However, we consider there is still an important methodology issue here.

32. More generally, we note that the range of uncertainty in the FES scenarios is almost as broad for the T-1 period as for T-4, which can be seen in Figure 13 of the ECR. This reflects the way FES cases converge in the later 2020s before diverging significant in the 2030s. The PTE suggests that properly specified, fundamental forecasting ranges using a probabilistic approach would reveal an increasing divergence as the future horizon is extended.

33. **Recommendation 74: ESO to review and clarify how the extreme FES scenarios can be quality assessed as predictors of ranges for the short-term forecasts and how, or if, they should be used alongside the estimated probability distributions around the Base Case.**

34. The PTE is not fully convinced that the end of Triad pricing arrangements for transmission charges, which previously saw over a 1 GW of demand shifting at peaks, has been completely taken into account. The ECR speculates that Triad Avoidance impacts will largely be replaced by consumer responses to peaky prices. This is an open question in view of the fact that very few consumers face half-hourly pricing in their tariffs, despite the market-wide initiative for half-hourly metering. We note that the ESO uses the unrestricted peak in its demand modelling (so DSR is only included alongside generation/storage). Whilst we recall that PTE Recommendation 59 on peak demand modelling in general was addressed by NGESO in ECR 2022, with a commitment to continue work on this topic, we think that more explicit analysis is required on the impact of the loss of Triad avoidance and the extent of offsetting by new flexibility services.

35. **Recommendation 75: National Grid ESO to monitor the change, if any, in demand responses to peak periods as a result of the Triad disappearance.**

36. The supply projection in the ECR is comprehensive and plausible. On the important consideration of non-delivery, we comment on the new methodology in this year's ECR later in this report. Essentially a new risk parameter is being included in the Monte Carlo simulations related to non-delivery, currently being estimated at 6%. This is instead of a range of separate non delivery sensitivities and has the effect of treating non delivery risk similarly to non-availability risk. It results in an increased expectation of the Base Case by 3 GW. We support this change but note some issues in its transition later in the Methodology section.

37. A new feature that we are seeing in this year's ECR is the impact of the end of ROC support for some of the biomass generation plant in 2027, which impacts about 2.5 GW. It still appears to be an open question what will happen to this technology. This also leads the ECR to assess a slight reduction in CM ineligible capacity from 12.8 GW to 11.8 GW between 2024/25 and 2027/28. In contrast, growth in distributed generation nameplate capacity increases between 2.5 GW to 5 GW by the T-4 deployment year.

38. Regarding over-delivery, we have raised in discussions with ESO whether a similar probabilistic approach to non-delivery could be developed. It was noted that over-delivery is sometimes the result of a unit that is expected to close being open longer and often associated with the uncertainty of smaller scale embedded resources. In both cases the data is less transparent than for over-delivery. Nevertheless, it seems appropriate to us that further analysis upon how over-delivery can be brought into the stochastic simulations should be developed.

39. **.Recommendation 76: National Grid ESO to consider how over-delivery can be brought into the general stochastic methodology alongside the progress already achieved with non-delivery and demand.**

Domestic De-Rating Factors

40. National Grid ESO has used the same methodology for calculating the derating factors as last year and so there are comparatively few aspects to comment on. Most conventional generation technologies continue to have de-rating factors in the high 80%'s to mid-90%'s, while nuclear remains below 80%. Figure 47 in the ECR shows stable availabilities between years in the high 80%'s to 90%'s for pumped storage, hydro, gas plant and biomass, with lower and fluctuating availabilities for coal and nuclear. Gas plant, dominated by CCGTs, continue to have lower availabilities than are typically recorded in many jurisdictions (e.g., those markets operating single buyer models with higher penalties for unavailability).

41. For the variable renewable generation technologies, wind and solar PV, National Grid ESO uses two distinct approaches. For the auction target capacity, the wind Equivalent Firm Capacity (EFC) is calculated by the Dynamic Dispatch Model (DDM) for the entire fleet. The

recommended auction de-rating factors, in contrast, are based on incremental EFCs for wind as calculated using the Unserved Energy Model (UEM). These incremental EFCs represent the contribution to security of supply brought by delivering any additional wind units via the Capacity Markets.

42. The ECR notes that for a system with a LOLE of 0.1-0.5 hours per year, the wind EFC calculated from the DDM is lower than it would be in a system with a LOLE of 3 hours per year. This is an interesting observation and indicates that care may be needed with LOLEs if bias is to be avoided. It is however potentially confusing to refer to an expected procurement of LOLE of 0.1-0.5 hours per year. Since the Base Case now includes a typical expected non-delivery of 3 GW, the LOLE for procurement this year is not directly comparable with that of previous years and is reported as 2.4 hours LOLE for T-1 and 2 hours LOLE for T-4.

43. The recommended auction de-rating factors for storage and renewables are calculated using the incremental Equivalent Firm Capacity (EFC) approach as before. This is a forward-looking approach which simulates the value of each Variable Renewable Energy (VRE) technology independently using the Unserved Energy Model (UEM) to estimate the equivalent capacity of firm generation for an incremental unit in a system at 3 hours LOLE. As previously, wind has a higher EFC than solar PV (which is to be expected given that PV is not available in the evening peak). The wind derating factors have increased slightly, while solar PV has increased more significantly by 1.8% to 5.1% for T-1, and by 1.4% to 6.4% for T-4. The ECR notes that derating factors for solar have increased as increased short-duration storage capacity shifts the distribution of stress events towards longer events that start earlier in the day (when there is some solar output). Whilst the PTE endorses the forward-looking, model-based approach to derive derating factors from EFCs, we think that sufficient data has now been accumulated to at least back-test these models and perhaps integrate a more statistical approach into the modelling. This raises the question of whether the use of a model-based equivalent firm capacity (EFC) is the best approach to estimating the contribution and derating factors of wind.

44. In future, as wind penetration increases, any stress events that do occur are likely to coincide with periods of low wind output – if wind output / availability is assessed on the P50 or P90 winter demand days used for conventional generation the security of supply contribution of wind generation in stress events is likely to be overestimated. Thus, it may not be desirable to use operational output / availability data in the same way as conventional technologies to estimate the de-rating factors for variable renewable energy resources. Similarly, a new approach may be needed to back test the de-rating factors as we have not experienced any stress events or a system at 3 hours LOLE.

45. It would be helpful to see further analysis of weather-induced correlated outcomes, e.g., between demand and supply for cold, still periods in which both wind is low and heating demand is high. Further use of operational data to update the wind power functions may also be timely, as the extent and heterogeneity of turbines has become more extensive, in order to create a longer time series of synthetic data for analysis. There would also be benefit in reviewing the wind scaling factor used in the DDM to ensure that the results of the

time-collapsed DDM model are consistent with the results of the time sequential UEM model.

Recommendation 77: National Grid ESO to consider the use of operational data for estimating wind derating factors with explicit reference to the weather-induced correlations between demand and supply and the calibration of wind power functions.

46. Derating for storage, which includes pumped storage, compressed air and batteries, is also calculated on an incremental EFC basis. There are marked changes from last year's ECR, with de-rating factors significantly reduced for both the T-1 year and the T-4 year. There has been a significant overall increase in the amount of shorter duration storage capacity in the 2023 ECR Base Case compared to the 2022 ECR Base Case. As a result, storage added thereafter comes with a reduced incremental EFC. There is a substantial interaction between storage and renewables: these complement each other, and the more of one there is, the lower its derating factor, and the higher the derating factor of the other. The increase in storage has decreased markedly the de-rating factors for storage and has less markedly increased the de-rating factors for solar.

47. National Grid ESO has initiated a review of its storage de-rating factor methodology, in response to last year's PTE recommendation "To consider the use of operational data for estimating battery derating factors instead of, or in combination with, the model-based EFC approach used at present". The PTE looks forward to discussing the findings and recommendations with National Grid ESO for the development of next year's ECR.

48. Derating for turn-down, demand side response (DSR), continues to be estimated based on the availability of non-BM STOR. The de-rating factor for DSR has increased over 7% to 79% since the 2022 ECR, largely due to STOR moving from seasonal fixed contract procurement to a day-ahead auction. There is a widespread view that DSR exhibits duration limits, either from genuine demand turndown capability or backup generation. We understand that National Grid ESO has proposals to address this, and we look forward to developments. The PTE suggest that, as with embedded generation, collecting more data on how DSR actually responds to market conditions may be useful. We therefore reiterate the value of our previous Recommendation 63.

Interconnector De-Rating Factors

49. Interconnector analysis has always been challenging. Firstly, because of their nature: they are transmission links but inject energy resources into the GB network like generators. Secondly, because an assessment of their contribution under stress events is quite hypothetical as there is an absence of sufficient historical evidence on flows under stress. As a consequence, the resource contribution and derating factor analysis is essentially model-based. The PTE recognises the difficulties and has been generally supportive in the modelling improvements. The modelling process this year is broadly similar to the approach of the last three years, but this year using Energy Exemplar's pan-European market model PLEXOS model for the first time.

50. A number (102) of stress periods are modelled: these time periods are constructed by scaling up GB demand so that even after imports there is load loss. The modelling identifies these 102 tight hours across a 34-year weather history (1985-2018). For each of a range of European scenarios and sensitivities National Grid ESO stochastically simulates different European plant outage patterns and GB stress periods to assess the potential impact of supply and demand uncertainty in Europe. In stress periods, National Grid ESO expect the price in Great Britain to be set by the Value of Lost Load with interconnector flows reflecting capacity in Europe that is available to provide imports to Great Britain. In essence, this is a capacity assessment, rather than an economic dispatch, so factors like market pricing are not relevant. The modelling does not distinguish between imports that are provided via the markets or through ESO trading actions – the assessment is simply one of how much capacity is available to provide imports to Great Britain during a stress period. Similarly risk and uncertainties arising from import unavailability due to politically driven events that prohibit markets operating in a perfect economic manner are not reflected in the modelling. National Grid ESO then calculate a de-rating factor for each interconnector across each sensitivity as an average for all outage patterns and stress periods.

51. Demand is only scaled up to force lost load after the tight period has been selected for assessment. Note however, that if demand is scaled up (or renewable supply is scaled down) in GB, then a natural question is whether demand is also scaled up (or supply is scaled down) in Europe at the same time: if not, the European contribution may be overestimated.

52. A development in interconnector modelling was made last year, with more extensive analysis of the simulations, and estimation of the density function of the ICDRFs for each interconnector rather than just the mean value. This revealed bimodal distributions with the interconnectors either flowing fully or not flowing at all, the mean values effectively reporting the ratio of each. This insight is consistent with the economic theory of market arbitrage and has implications for risk in the DDM as well as the average country specific derating factors.

53. The data analysis reported in Section 5.2.5 of this year's ECR shows that interconnector imports are less than 40% of the total interconnector capacity for over 15% of the modelled tight hours. On the other hand, 80% of the total capacity is available for around 70% of modelled GB tight hours. Figure 32 indicates that since the last ECR the percentage of total capacity delivered in the modelled tight hours has decreased; less than 50% of capacity was available for approximately 21% of these hours. Whole fleet imports are dominated by France, which the ECR notes has a greater correlation of tight hours with GB than any of the other markets.

54. Taking all these factors into consideration we also undertook a careful comparison with the previous year's derating factors and the reasons why they may change this year. Given the very wide ranges presented in the ECR, and the implied uncertainty, we have been pragmatic in not seeking to unduly create excessive year by year changes in the recommended ICDRFs. Although the Base Case average derating factors in the ECR are larger, we have made lower suggestions that reflect our concerns about correlated bimodal flows and thereby remained closer to last year's recommendations. We have proposed the following derating factors (with our 2026/27 recommendations for comparison):

PTE Recommended Country De-rating Factors		
	2026/27	**2027/28**
Ireland	55%	55%
France	70%	65%
Belgium	65%	65%
The Netherlands	62%	62%
Denmark	60%	60%
Norway	91%	91%

55. The only change from last year is for France, in which the correlation of tight hours with GB noted in the ECR inclines us to lower this year's recommendation despite the 70% average Base Case estimate.

56. In making these recommendations, we have formed a view based upon the results and commentary in the ECR. As with the ECR, there has been no attempt to guess the progress and implications of the geopolitical crisis in European gas from Russia. This was outside the scope of the ECR and we leave it for the Government to assess and adjust accordingly.

57. In the modelling of the risk from interconnectors, the critical time periods considered are constructed by scaling up GB demand to produce stress. In the past, peak risk and tight supply conditions occurred when demand was highest. With increasing dependence on wind and solar generation in both Britain and Europe, and more interconnected capacity, risk may be shifting out of these peak load periods and into periods when load is lower but resource availability is also lower, due to correlations (e.g., periods of low wind and solar generation) across Britain and Europe. It would be helpful to understand whether the simulated supply in Europe at the 102 stress periods are conditional upon, or independent of, the weather conditions in Britain in those periods.

58. **Recommendation 78: National Grid ESO to explore further the risk arising from correlated weather patterns across Europe. In particular, to continue the statistical analysis of ICDRFs to understand the implication of weather correlations on the aggregate risk of GB interconnections at times of stress and to consider potential new risk measures that go beyond simple averages in order to better represent the risks from bimodal and correlated flows.**

Methodology

59. The PTE has always made a number of recommendations in its previous reports. Last year's (2022) PTE report made 8 new Recommendations. All these recommendations, along with others raised by the Department of Energy Security and Net Zero, Ofgem and National Grid ESO's internal post review/update processes were considered by National Grid ESO. Below we summarise our comments upon how these 8 Recommendations have been developed.

PTE #	PTE 2022 Recommendations	Progress and PTE Comments
66	To accelerate the work on the statistical representation of peak demand uncertainty around the Base Case for the T-1 and T-4 years with a clear identification of what uncertainties can be modelled statistically and what are being left to expert judgement.	This has progressed well and has led to the useful simulations of uncertainty in this year's ECR. We note that work on this is continuing and that it will be an essential ingredient of a fully stochastic simulation model. We encourage its development to full potential.
67	Analysis of the price elasticity of demand by market segments in order to better understand the underlying demand under current high prices and potentially project future high price sensitivity more accurately.	This is apparently implicit in some of the demand sector work but it has not yet developed into an explicit representation. We encourage continuing attention to this aspect.
68	To consider if the capacity of facilities providing ancillary services is being accounted for properly in the resource adequacy calculation under stress events.	This has been progressed carefully and has been well-described by National Grid ESO in the ECR
69	To investigate if network infrastructure constraints present a material degradation of the achievement of the reliability standard for capacity adequacy.	A preliminary analysis of this issue has been undertaken and National Grid ESO does not consider it material at present but will keep it under consideration.
70	To consider the use of operational data for estimating wind derating factors instead of, or in combination with, the model-based EFC approach used at present.	Not progressed this year. We expect this to be re-considered following the conclusion of the similar project related to storage (PTE 71 below) as it has become within the scope of new Recommendation 77.
71	To consider the use of operational data for estimating battery derating factors instead of, or in combination with, the model-based EFC approach used at present.	This work is being developed and will be concluded over the coming year.
72	To expand the statistical analysis of ICDRFs to fully understand the implication of bimodal distributions for individual flows and their correlations on the aggregate and individual risks of GB interconnections.	This work has continued and has been included in the modelling software for the ICDRFs migrated to a new provider. Good progress has already been achieved and we expect further analysis on this important issue.
73	The modelling parameters in the ECR related to the reliability standard are not well matched to the preferences and policies of procurement. It would improve the relevance of the ECR exercise if the Department for Energy Security and Net Zero were to reinstate its intention to review the reliability standard and its implementation.	National Grid ESO indicated that this needs to be considered by the Department of Energy Security and Net Zero and Ofgem, and the PTE maintains that the reliability standard should be fully reviewed.

60. In addition to the above Recommendations, PTE 60 phase 2 “Modelling non-delivery probabilistically” was substantially advanced and became an integral part of the analysis in this year’s ECR. We congratulate National Grid ESO in its implementation and consider it to be an important step forward in refining the methodology for considering the uncertainty in potential non-delivery. In moving from forward assessments of sensitivities to a historical record of non-deliveries there are pros and cons. The PTE advocates the move, on balance, as it gives the analysis a more empirical basis, but judgement will still remain delicate, both in retrospect with regard to whether some non-delivery events were rare and extreme (and might thereby over-influence the base rate) and prospectively if it is thought that new policies might lead to a change in the propensities towards non delivery (e.g., tighter compliance rules when they apply and/or the emergence of more liquid secondary trading of CMUs).

61. We note that whilst it may appear that non-delivery and non-availability are becoming similarly modelled through probabilistic simulations and that in the time collapsed DDM modelling for GB procurement they become functionally equivalent, nevertheless there is a fundamental difference over time. Non-availability events are expected to be of short duration whilst non-delivery events are season-long. Thus, in the time sequenced model, UEM, they are quite different and non-availability outage lengths are modelled stochastically. We wonder if the increased concern about longer-duration storage and extended weather-related events may suggest that going forward, time-sequenced modelling will have to become the norm and that the duration of outages may have to be modelled more explicitly. This suggests an increasing reliance upon the UEM modelling developments going-forward.

62. The Least Worst Regret (LWR) criterion has been fundamental to prescribing an optimal procurement in the face of multiple uncertainties as represented by sensitivities and scenarios. Through PTE 60 and PTE 66 the uncertainties on non-delivery and demand are being represented statistically in the risk simulations, rather than via the alternative sensitivities in the LWR. This is a good move and begins to align the approach better with risk analysis, stress testing and value-at-risk analytics which are conventional best practice in risk management elsewhere. However, in ECR 2023 and perhaps also next year, the methodology is intermediate between LWR and a fully stochastic risk simulation. Careful attention is needed to be pragmatic and coherent in this intermediate modelling stage to avoid any double counting (of outcomes included in both the risk simulations and the leftover LWR analysis). At this point, we recommend that greater clarity is articulated upon how the risk simulation results will ultimately be used to define a procurement target (perhaps for example as the 95% quantile that an LOLE of 3 hours will be met) and whether there is the expectation that there will still be some residual LWR (with, for example, a few such quantiles) and/or stress testing of the more extreme scenarios around the Base case.

Recommendation 79: National Grid ESO to present a vision of the procurement decision analysis framework as the methodology evolves away from LWR to a fully stochastic risk simulation.

63. It is worth emphasising that in reaching this intermediate stage of modelling with a mixture of stochastic risk simulation and LWR, the ECR 2023 is making significant departures in methodology. Firstly, prior to this year, the Base Case approach assumed that there would be no non-delivery and that the risk of non-deliveries would adjust procurement away from the base case according to the LWR sensitivities. Now, there is an expectation of a "normal" amount of non-delivery in the mean of the Base Case simulations. Secondly, the methodology is effectively moving towards combined sensitivities as the joint distributions of the various events (demand, weather, non and over deliveries) become part of the risk simulations. That is a significant and more appropriate approach than the LWR structure where the events were analysed as being mutually exclusive (and the previous analyses suggested that combined sensitivities were too rare to be considered in the LWR).

64. Looking further ahead, the non-CM uncertainties may start to become more material and consideration may soon have to be given to how under/over delivery of CfD projects become estimated and included in the risk analysis.

65. Also, looking ahead, even though the focus of the annual ECR has been to provide parametric inputs for the T-1 and T-4 auctions, there has always been a requirement to provide a background 15-year outlook. With technology change, and potentially large lumpy changes in capacity, it may well be appropriate to take the T-4 decision with the benefit of some degree of prospective analysis. If, for example major demand or supply disruptions are anticipated at, or not so far beyond, five years, or the requirements for longer duration storage become significant, procurement at T-4 may well need to be adjusted appropriately. We suggest it may be timely for National Grid ESO to give some consideration to how the T-4 procurement decision should include some look-ahead contingency analysis. This may include, for example, a prospective assessment of what T-X may look like where X is perhaps 5-8. Related to this, and in the context of the REMA deliberations on the future capacity market arrangements, we suggest that it may be timely for the Department of Energy Security and Net Zero and National Grid ESO to consider whether T-1 and T-4 remain the optimal target years for resource adequacy procurements. The technology mix has changed since EMR began and there has been substantial learning on project development timelines. The PTE are aware that their terms of reference exclude policy matters, but with REMA on-going and optimal procurement being dependent upon the emerging technology and project management constraints, we consider this to be an important aspect to re-assess.

Recommendation 80: National Grid ESO to provide some methodological suggestions on a more future-contingent approach to T-4 procurement in order to take account of the prospect of emerging disruptions in the energy transition.

Recommendation 81: National Grid ESO and the Department of Energy Security and Net Zero to consider whether T-1 and T-4 remain the optimal target years for resource adequacy procurements.

Conclusion on Target Capacities

66. Overall, we note the continued improvement in methodology for producing the ECR and whilst we have, as usual, presented a number of recommendations, we hold the opinion that the work is comprehensive and thoroughly undertaken. We endorse its fitness-for–purpose. We recognise the market has altered significantly since the Capacity Market started and therefore the modelling challenges have changed. We wish to express our appreciation of the constructive manner through which National Grid ESO and the Department of Energy Security and Net Zero have engaged with the PTE.

67. For T-1, we accept the recommendation of 7.4 GW in the ECR. We recognise that this gives a similar derated margin to the previous targets. The energy security circumstances last year led to a high level of risk aversion and a high procurement. Whilst the management of those supply risks may now be clearer, we accept that the level of risk in the outlook remains unusually high.

68. For T-4, we accept the 44.5 GW recommendation in the ECR. In setting the target for T-4, the Department of Energy Security and Net Zero will implicitly be considering what may be required at the subsequent T-1 for the same year and explicitly recognising some of this in any set-aside. Purchasing more or less at T-4 with T-1 in mind is a delicate issue. PTE57 previously raised the issue of optimal procurement across these two opportunities, although work on that recommendation became too awkward to formulate in practical terms. We do not make a further recommendation to re-activate PTE57, but we note that there is scope for further thinking on this topic. In particular, our intuition is that the decision criterion could be less risk averse for T-4 given the opportunities for the supply/demand balance to adjust in the meantime and be adjusted ultimately at T-1.

69. Thus, without having direct evidence to alter these targets, the PTE is concerned not only about the current energy supply risks, but also about potential over procurement and the consequent costs to society. We anticipate that more information will become available in time for any autumn adjustment and that a careful re-evaluation of the demand forecasts and supply-side assumptions (particularly on expected non-delivery) should be undertaken ahead of the auctions.

Quality Assurance

70. Previously followed procedures continue to provide QA and these are closely aligned with the Department for Energy Security and Net Zero internal QA processes. The PTE previously requested details of the ECR Quality Assurance methodology and this was reproduced in Annex 2 of PTE's 2016 report.

This publication is available from: www.gov.uk/government/publications/national-grid-eso-electricity-capacity-report-2023-findings-of-the-panel-of-technical-experts

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