Panel of Technical Experts

Report on the National Grid ESO Electricity Capacity Report 2020

July 2020

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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 BEIS for the subsequent Capacity Market auction procurements, through this report and informal consultations.

2. The annual scrutiny cycle for this PTE report started in August 2019 with consideration of several special projects being undertaken by National Grid ESO related to their modelling. These deliberations continued through the autumn. By April and May 2020, the PTE were presented with the initial results from the modelling for the 2020 ECR.

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

4. In fulfilment of our role, we have scrutinised National Grid ESO's 2020 Electricity Capacity Report on the target capacity for the proposed T-1 Auction for delivery year 2021/22 and the T-4 Auction for the year commencing 2024/25, and this document presents our conclusions.

5. Through our previous reports (2014-2019), the PTE has made 51 Recommendations in total (of which 10 were from 2019) for improving the methodology and reliability of the modelling by which target capacities are calculated. National Grid ESO has taken action on most of these as reported fully in Annex 1. As usual, we make some more Recommendations, a further six, 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, BEIS and Ofgem throughout the process of National Grid ESO formulating the Electricity Capacity Report 2020 and we are content that this presents a thorough and carefully executed analysis. Over recent years the analytical process has improved. Subject to the qualifying comments which we have made in this report, we are content that the approach to deriving the target capacity, including the specification of de-rating factors, are as reliable as they could be at this stage of development, given available data and analytical capabilities.

7. For the second year in succession there has been a major change to the way National Grid ESO have modelled European power flows. This year the stochastic simulations have been focussed on stress periods more precisely defined as circumstances when GB expected demand is higher than available supply including imports. Previously the selection of stress periods was only when GB required imports. This new method is part of a process of continuous improvement in a difficult area of modelling. It has led to significantly different interconnector ratings from 2019, but we consider them to be preferable and more robust.

8. We carefully considered and agreed on the sensitivities that went into the estimations leading to the application of the 'Least-Worst Regret' criterion to determine 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 ECR recommendation of zero. We are aware, however, that BEIS will be obliged to hold an auction and according to legislation this must be for at least half of the set-aside from the previous T-4 procurement for 2021/22.
   - For T-4, whilst we accept the analysis leading to a procurement of 41.6GW, as being coherent from the assumptions made pre COVID-19, we expect some of the assumptions post COVID-19 will need to be revised and we welcome the opportunity to re-consider the new evidence which will be presented in September 2020.

10. We raise a number of concerns. Again, the lack of data on embedded generation capacities has been a problem, although we are hopeful that processes are in place to create a comprehensive register for next year. This year we have raised, for further consideration, an emerging issue around the overall methodology for dealing with uncertainty and formulating the appropriate degree of caution in determining the procurements at T-4 which may be creating persistent problems at T-1. That will require further study. On the other hand, we are pleased to report that the systematic bias towards over-forecasting demand which we identified in the 2019 PTE Report has been remedied by National Grid ESO to our satisfaction.

11. We give our recommendations for interconnector de-rating factors in the following table. From the wide range of scenarios and approaches for estimating these de-rating factors, we have determined that close reference to the simulations based upon the EU policy of harmonising the reliability standards across member states, as progressed through ENTSO-E and ACER, is the most coherent and credible basis.

PTE Recommended Country De-rating Factors		
	2021/22	**2024/25**
Ireland	60%	50%
France		76%
Belgium		69%
The Netherlands		63%
Denmark		57%
Norway		99%

12. Overall, we were very pleased with the open and constructive process of engagement with National Grid ESO and BEIS. 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 new approach to interconnector derating estimation. During the course of this engagement, we identified some wider methodological issues which reflect the rapidly changing nature of the electricity system and we recommend further work on these.

Recommendations

13. The new recommendations in our report are listed below. (The numbering follows on from the 51 recommendations in previous PTE reports).

Recommendation 52: The factors affecting the evolution of peak behaviour should be analysed more explicitly from the broad perspectives of current and future technical, society and regulatory evolutions.

New Recommendation 53: As new data on embedded generators becomes available, consider specific derating factors for embedded plant types.

New Recommendation 54: Future ECR analysis of Base Case and over-delivery sensitivities should explicitly take note of the fact that not all eligible plant will either enter the CM or close.

New Recommendation 55: List the modelling assumptions and limitations that might bias the interconnector ratings either up or down and comment on their materiality.

New Recommendation 56: The Technical Reliability of HVDC links should be considered more fully and whether the technical reliability of interconnectors, and perhaps private links to large offshore wind farms, should become more explicitly part of the procurement methodology in future.

New Recommendation 57: We recommend that National Grid ESO undertake a fundamental analysis of the sequential nature of the capacity procurement, taking account of the appropriate caution needed in relation to the quantifiable and unquantifiable uncertainties, risks and their consequent costs.

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 BEIS for the subsequent Capacity Market auction procurements.

15. The PTE's first report on National Grid ESO's analysis to inform Capacity Market decisions was published in June 2014. This is the PTE's 7th report, focused on the recommended capacity to secure for the 2024/25 T-4 auction and for the 2021/22 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 BEIS by Professor Derek Bunn (Chair), Dr Guy Doyle, Professor Nick Jenkins, Professor Frank Kelly and Lisa Waters.

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 BEIS 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, 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. The role of the Panel is a technical function and not a forum for policy commentary or for 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, for example, on

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

the Reliability Standard to be set by Government or the mechanisms chosen to achieve its objectives.

Process

20. During the course of the PTE's work, National Grid ESO has presented its methods, assumptions and outputs in relation to its 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, BEIS and Ofgem regularly during the autumn/winter 2019/20 to discuss development projects, the production plan and modelling outputs for 2020. Subsequent to the meetings, the PTE provided interim views to BEIS before presenting preliminary drafts of this report for further considerations and feedback from BEIS, 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:

    a. Demand evolution

    b. Non-delivery estimation and aggregation

    c. Interconnector de-rating

    d. The unavailability of embedded generation and DSR data

23. As required by the PTE's Terms of Reference, the PTE also kept in mind the circumstances for National Grid ESO to be confronted by potential conflicts of interest. The PTE, throughout this process, has sought to mitigate this by vigorously challenging assumptions and 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 to 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 BEIS, 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. The major elements are domestic Demand and Generation, together with an increasing reliance upon Interconnection resources from neighbouring countries. We therefore organise this section according to these three main elements.

Demand Forecasting

27. Forecasting peak demand is the natural starting point for the ECR, and the methodology undertaken by National Grid ESO follows the same principles as in previous years. This is actively being refined and improved. The PTE is reassured that the process is thorough and considers all the main drivers of demand. The Underlying Demand is made up of metered National Demand (75%), Distributed Generation (23%) and Demand Side Response (1.2%). National Demand has reduced by more than 11 GW in the 10 years to 2019/20. Demand forecasting has become increasingly difficult with changes in consumer engagement and embedded energy resources. We have discussed at length the steps taken by National Grid ESO to remain vigilant to these changes and have actively supported efforts to improve data on distributed resources.

28. The four FES scenarios, which will be published by National Grid ESO later this year after release of the ECR, provide useful projections, overviews and ways of thinking about the energy transition. Although the main focus for the capacity to secure is the short-term Base Case, the FES scenarios together with Base Case sensitivities are important in determining the capacity to procure through the Least Worst Regret criterion (see Annex 2).

29. Under Recommendation 43 National Grid ESO was asked to explain and de-bias the demand forecasts in the 2019 ECR. This was addressed in a presentation to the PTE in September 2019 followed by a discussion at the PTE meeting on 29 April 2020. The conclusion is now that although errors in predicting demand remain, these are now symmetrical and that consistent bias has been removed in the current forecasts. The PTE were satisfied that no further steps to reduce consistent bias in demand forecasts are appropriate at this time. We are pleased to see that this has now been systematically corrected.

30. Recommendation 44 was intended to provide a more explicit analysis of the potential load shape evolutions and their implications for peak demand. This recommendation was not taken forward in 2019/20. A number of technical (e.g. smart meters), societal (e.g. home working) and regulatory (Triad removal) changes are expected to affect the peak behaviour. We note however that National Grid ESO consider Underlying Demand, rather than National Demand to be the main driver for procurement and so careful consideration of distributed generation and demand-side responses are necessary. In Recommendation 52 we suggest a revised and expanded version of Recommendation 44 for consideration by National Grid ESO.

31. For example, the rollout of smart meters is intended to encourage customers to alter their demand profiles and respond to price signals from their suppliers. The PTE are aware that several suppliers have trialled tariffs using the capabilities of smart meters. Data from these trials may be reviewed by Ofgem or BEIS, as part of their ongoing policy development, and learning from these schemes may be important to ensure that there is no over delivery under the Capacity Market in future years.

32. At the time of writing, the state of the industrial and commercial market remains in flux as a result of the Covid-19 pandemic. National Grid ESO has reported a substantial reduction in demand against expected seasonal normal levels and there has also been a change in the timing of the peaks. As GB returns to a "new normal", National Grid ESO will need to consider whether there are sustained societal changes if working from home continues.

33. The PTE notes that Ofgem's timetable for their charging reforms has slipped for a variety of reasons. However, the direction of travel, with more fixed charges on customers and a reduction in embedded benefits, will change behaviour, notably of the largest customers and the embedded generators. The behaviour of the embedded generators is easier to forecast, as they will run as a result of weather (solar and wind) or as market prices dictate (conventional generation and storage). However, the PTE is concerned that the response of customers is more uncertain. If there is no triad signal in 2023/24, will peak load in winter increase or will more customers acquire on-site generation?

34. Apart from the rollout of smart meters, encouraging the uptake of EVs and the electrification of heat are potential major technical and behavioural changes. As the move to net zero carbon progresses, it is likely that further policy developments may also encourage a switch from other sources of energy to electricity. The scale and speed of such changes is already subject to examination by other bodies, such as BEIS and the Committee on Climate Change. Whilst such factors are key elements of the work on FES, the PTE encourages National Grid ESO to analyse these and other peak drivers more explicitly in future ECR reports. As part of this work, it may also be worth considering how the evolution of peak demand could impact the scaling of historical demand time series, which are used to construct the demand distribution for the LOLE calculation.

    Recommendation 52: The factors affecting the evolution of peak behaviour should be analysed more explicitly from the broad perspectives of current and future technical, society and regulatory evolutions.

35. The PTE notes the market developments which are intended to encourage embedded generation and demand-side response (DSR) to join the wholesale market, i.e. National Grid ESO's Distributed Energy Resources (DER) desk, new services such as Optional Downward Flexibility Management (ODFM) and the introduction of Virtual Lead Parties (VLPs). Further developments along these lines would give National Grid ESO improved sight of and access to, additional controllable capacity, which the PTE welcomes. These developments should allow National Grid ESO greater ability to influence the peak transmission demand and, combined with registers of embedded assets, will provide additional data to inform the modelling process. We welcome these developments.

Generation Forecasting and De-Rating Factors

Station Availability

36. Under recommendation 45 the PTE had suggested that work should be done to consider if the reliability of plants was reducing as they aged, with the focus on nuclear, coal and older gas plants. The de-rating methodology is backward looking, based upon the past 7 years performance, as determined by legislation. Hence, the PTE had concerns that the de-ratings may not be capturing more recent changes in reliability, if any, of older-aged power stations. In particular, it was speculated that maintenance standards may decline as plants approach retirement, as well as natural deterioration. The PTE welcome the work that National Grid ESO has done in this area, concluding that aging plant is no less reliable.

37. The PTE therefore continue to support the de-rating methodology used by National Grid ESO for conventional plants. For limited duration and intermittent facilities, the PTE has engaged with the projects which have focussed upon determining their derating factors and endorse their current derating factor determinations, in particular the use of the Equivalent Firm Capacity methodology.

38. PTE Recommendation 51 proposed that National Grid ESO develop a methodology for dealing with co-located sites. The PTE welcomes the work they have done on this to date and note that their current view is that the methodology works where a site has enough connection capacity for all assets on the site, regardless of their technology, allowing each asset to be derated in line with its technology class. The PTE notes that National Grid ESO intends to keep working on this and we fully support that.

39. The PTE suggest that the embedded dimension is an emerging consideration of co-location at the retail level, e.g. co-location of storage with solar and/or with EV charging, and this aspect should be part of Recommendation 52 looking at peak demand changes

40. While National Grid ESO makes it clear in their report that they have not yet had time to consider and model the potential impacts of Covid-19 on the electricity market, the PTE have discussed with National Grid ESO, BEIS and Ofgem that there may have been further delays in maintenance works, not only following the Capacity Market suspension last year, but as companies have not been able to get staff or equipment to sites given the Covid-19 restrictions of social distancing and travel. While larger generators report outages under REMIT[2], there may be increased risk of power plant failures where maintenance has been delayed. We expect National Grid ESO to report on this as part of the procurement review in September.

Embedded Generation

41. Under recommendation 47, the PTE proposed that National Grid ESO should acquire more robust data on embedded (i.e. distributed) generation to inform their forecasting (a request the PTE has been making since 2017). The PTE therefore welcome the work

[2] REMIT is an EU regulation on energy market integrity and transparency (No 1227/2011). It has been in force since 28 December 2011.

done on the Distribution, Connection and Use of System Code (DCUSA) change proposal DCP350, Creation of Embedded Capacity Registers[3]. While this change has yet to be approved by Ofgem, if implemented it should, before next year, allow National Grid ESO access to far better data for their forecasting. The PTE would like to thank all the market participants who worked on this change proposal and trust it brings the wider benefits, as expected, to the market.

42. As a result of DCP350, assuming it is implemented in time, we recommend that National Grid ESO considers if and when it would be appropriate for the de-rating of embedded generators to be done using data from that subsector rather than using the de-ratings of larger plants and applying them to smaller ones. There have been assertions that the de-ratings should be different for embedded plant, partly due to their average age and partly due to their configuration (being made up of multiple smaller units) making them more reliable by design. Access to robust data is needed before any methodological changes are implemented, but we continue to believe that each technology within the Capacity Market should be derated according to its distinct characteristics.

New recommendation 53: As new data on embedded generators becomes available, consider specific derating factors for embedded plant types.

43. The PTE is also aware that Ofgem's charging reviews will impact the economics of embedded plants, reducing or removing their embedded benefits. While Ofgem's charging changes are progressing and until the full package is implemented, it is difficult to assess what the likely impacts on embedded plant, notably forward investment will be. This subsector may also be impacted by the Clean Energy Package[4], which limits emissions and/or operating hours depending on site specific factors. These changes may result in plant closures as not all embedded plant will be economic. Again, the PTE hopes that with the registers of embedded plant these changes can be more closely monitored and a better understanding of the embedded generation retention and investment drivers can be developed by the modelling team at National Grid ESO.

44. This year the changes to the Capacity Market Regulations, recently bought in by BEIS in response to the EU Commission's clearance, will also reduce the threshold for the size of generation eligible to join the Capacity Market to 1MW (from the current 2MW). The PTE believe that National Grid ESO have reasonably accounted for this change, but we suspect most generators of that size are part of industrial or commercial sites and may well appear as DSR rather than generation. Again, the register of embedded assets will hopefully help the whole market better understand the structure of this subsector of the market.

Non-Delivery and Over Delivery of Generation

45. From consideration of National Grid ESO analysis, the PTE notes that the market generally appears to close plant due to fundamental plant economics rather than from discernible decreases in reliability. This seems, at least in part, to be driven by the fundamental change in the generation mix of the GB electricity market, which is starting

[3] https://www.dcusa.co.uk/event/dcp-350-creation-of-embedded-capacity-registers/
[4] The Clean Energy for all Europeans Package comprises eight different legislative proposals which update the European energy policy framework.

to value flexibility more highly. When looking to 2024/25 and beyond it is well known that several plants are likely to close. The Government's stated policy is to close all unabated coal by 2025, but from the latest auctions results it would appear only Ratcliffe may be open in 2022. There were also several gas plants that did not take agreements in the recent auctions, and they may also be considering closing. We observe that it is often a combination of factors which create delivery problems, eg it may not be worth immediately repairing plant after breakdowns when market conditions are poor.

46. On nuclear, the PTE observes that Hinkley Point B opted out of the T-4 auction and did not take an agreement in the T-3 auction earlier this year. Hartlepool also chose not to take agreements in either auction, and Heysham 1 did not take an agreement in the T-4 auction. Hunterston B opted out of both auctions, on the basis of being operational in 2022/23 but decommissioning in 2023/24. These choices appear to put the nuclear closures on a similar trajectory to that outlined in the 2019 Future Energy Scenarios. While Hinkley Point C is currently due to start generating in 2025, prudent consideration of international experience suggests that this date may not be met.

47. The PTE's role is to consider whether the analysis done by National Grid ESO is robust and accounts for market developments. Over the course of the past few years the termination fees associated with the Capacity Market have increased, and this may deter plant from taking obligations as they near the end of their lives, though there is less risk for portfolio players. Changes in operational generation are difficult to assess in advance, but the auctions have given some earlier view of investor sentiment, albeit that plant not taking agreements in T-4 auctions can re-enter at T-1. The general direction of travel seems to be in line with National Grid ESO's forecast, but their assumption that all eligible plant will enter the Capacity Market or shut may no longer hold true. Instead this may need to be accounted for more explicitly in the sensitivity analysis around over-delivery.

New Recommendation 54: Future ECR analysis of Base Case and over-delivery sensitivities should explicitly take note of the fact that not all eligible plant will either enter the CM or close.

48. The PTE welcomes the explicit inclusion of the non-delivery risk from nuclear to capture the recent issues seen with plants returning from outages. This also helps to account for the nuclear plants not taking on obligations in the recent auctions. In future years the treatment of the nuclear fleet will require further consideration as older plant comes off and new plant commissions. Given the progressively smaller size of the nuclear fleet going forward, and their heterogeneous characteristics, we wonder if each station should be considered separately in future analyses rather than being grouped homogenously. Evidently commercial considerations preclude such a specific analysis being public, but as part of the underlying analysis, it would be sensible for National Grid ESO to capture the specific circumstances of each of these large facilities.

49. Looking at the Capacity Market registers, there have not been many terminations for 20/21, but there are more for 2021/22. It is difficult to monitor how much new build capacity is also running late or will not be built, but we note that BEIS has made changes to the Capacity Market Regulations, in light of the Covid-19 pandemic, to give parties greater time to achieve milestones and thereby encourage delivery of committed capacity. The PTE welcomes this pragmatic approach which is in the interests of customers. However, it will make it more difficult for the Delivery Body to know how much capacity is being delivered late or may even be terminated. This is something

on which National Grid ESO will need to advise BEIS before BEIS considers any adjustments to the target capacity for the T-1 auction for the 2021/22 delivery year.

50. In contrast, over delivery can arise in several ways, with opted out plant staying open, some developers build more capacity than expected or parties deliver capacity earlier. It was a particular feature of the earlier T-4 auctions that some new embedded generators were built a year early and then went into the T-1 auctions, giving investors 16 years of Capacity Market income. Now we are seeing more existing capacity opting out at T-4, but some may go into the T-1 auction or stay open with no agreements.

51. Whilst it is outside our scope to advise on the auction process, we would observe that it would be helpful if BEIS were able to pull the auctions back into December, so that the results could more easily be accounted for in National Grid ESO's subsequent ECR modelling. With the T-4 2019 auction not held until February 2020, the time for National Grid ESO to update its modelling has been too restrictive. We also noted that the current timing of the auctions means that T-4 does not actually allow new build a full 4 years to build. This may be creating a delivery risk for larger plants. With increasing numbers of larger plants reaching the ends of their lives, the market design should try to create a level investment playing field for all competing technologies.

52. The Capacity Market was designed to ensure that there is enough capacity to keep the lights on against the background of an explicit Loss of Load Expectation (LOLE). However, any market can suffer an event that it can adapt to, but it may also be susceptible to a series of events or a large and unforeseen even that is a "Black Swan" event, or "the perfect storm". In the PTE's last report we noted that the AGR nuclear fleet is aging, operating under extended life permissions, and two stations, Hunterston B in Ayrshire and Dungeness B in Kent, had experienced extended outages over the previous year. We further noted that structural integrity of the graphite core has been cited as the ultimate limiting factor to the lifetime of the AGR reactors. The PTE was therefore concerned about the potential for common-mode faults impacting a type of plant[5] and asked National Grid ESO to consider Black Swan events in its modelling (PTE Recommendation 46).

53. The PTE is grateful for the work that National Grid ESO has done on Black Swan events, looking at both unexpected outages and weather. We agree with the conclusion that to include such low probability events in their sensitivities could give misleading results and therefore should not be part of the capacity procurement assessment. However, there are operational lessons to be taken from recent outages, stress events and the demand destruction from Covid-19, which can inform contingency planning for unlikely events.

[5] The French nuclear fleet has seen a type fault as did GB CCGTs in 2018.

Interconnector Flows and De-Rating Factors

54. The requirement of the interconnection analysis by National Grid ESO is to estimate a range of de-rating factors for each interconnected country for the auction years. PTE is then required to determine proposed values within those ranges. In previous years National Grid ESO have looked at a combination of backward-looking (historical data) and forward-looking (model-based) analysis to provide the ranges. However, the historical values have been regarded as setting unrealistic levels going forward. The lack of stress events in the data is of particular concern. Furthermore, analysis has shown that it is logical to expect derating factors to decline over time as more interconnectors get commissioned. We do, however, believe that reference to historical values is a useful comparator, alongside other evidence and we intend to explore this in a more formal way as a special project later this year[6]. Instead, for this year, as in 2019, National Grid ESO have used pan European modelling under various assumptions to provide the ranges for each country. But unlike 2019, the modelling this year is predicated upon identifying, through extensive simulations, the stress periods in which expected demand is higher than available supply including imports. This is a stricter definition than previously in 2019, which only looked at periods when GB demand was greater than GB available generation. As before, there had to be an artificial demand uplift in order to ensure enough stress periods to represent 3 hrs LOLE. PTE agree with this new approach, and we note that industry feedback has generally been supportive on this modelling improvement. It does mean however that the de-rating factors have changed since 2019. We do not regard this as an inconsistency, but a reflection of on-going modelling improvements.

55. In terms of the modelling, the stochastic simulation of all generators in the relevant EU neighbouring countries under historic weather conditions and various sensitivities is a sound approach and we consider it to be fit for purpose. As with all models, there are simplifications and real-world frictions that do not get represented. It remains an open question whether real flows at times of stress may be compromised by system constraints or operational factors not represented in the model. It would be useful if National Grid ESO listed factors which might bias the model-based estimates in either direction, commenting upon their anticipated materiality.

    New Recommendation 55: List the modelling assumptions and limitations that might bias the interconnector ratings either up or down and comment on their materiality.

56. The upper levels of the range for the interconnector derating factors were set by the National Grid ESO assumptions for FES. The most extreme FES defines the maximum, not the average of all FES results. We agree with the view expressed in the ECR that these assumptions imply a surplus of capacity in the interconnected countries, and as a consequence are likely to be overestimates as countries adjust to a harmonised EU reliability standard over the next few years.

57. Thus, we commend the alternative set of interconnector values based upon the same modelling principles, but under the assumption that the EU harmonisation directive is effective and all countries move to a 3 hr LOLE standard for T-4 (except for Ireland which may retain its 8 hour LOLE standard). We believe this to be a credible vision and

[6] As requested by BEIS in "Proposals for further amendments to the Capacity Market" May 2019.

one that can be defended through consistency with European policy intentions. As it turned out, the derating factors so produced were, with the exception of Ireland, in the middle of the wide ranges produced by National Grid ESO.

58. The lower levels of the range were set by considerations of a French nuclear sensitivity involving around 10GW of additional long-term outages. The ECR report documents the recent yearly French nuclear availabilities and this worst case sensitivity does indeed appear to be credible and provide an appropriate lower bound. We note that the FES "Leading the Way" scenario produced the lowest values, but these were disregarded by National Grid ESO as being unrealistic in the near term. We agree with this ad hoc reasoning as the overall FES methodology is derived around long term decarbonisation targets and is not specially calibrated to extrapolate the short term trends.

59. Table 31 in the ECR, which is reproduced below, shows the range of de-rating values summarised by National Grid ESO for consideration.

Table 31: De-rating factor ranges by country, excluding Leading the Way

Country	Delivery Year	Minimum	Maximum
Ireland	2021/22 2024/25	54% 24%	99% 66%
France	2024/25	50%	91%
Belgium	2024/25	46%	88%
Netherlands	2024/25	48%	84%
Germany	2024/25	N/A	N/A
Denmark	2024/25	45%	80%
Norway	2024/25	91%	100%

60. For Ireland, 2021/22, the maximum is 99% in the Base Case and all FES, whilst the minimum of 54% is set by scaling down Irish Thermal capacity. For 2024/25, the maximum scenario is 66%, but the Base Case and other scenarios (excluding "Leading the Way") are around 50%. We note that the European LOLE standard simulations in this 2024/25 case are close to the minimum. Last year we recommended 57% for 2022/23 and 45% for 2023/24. For 2024/25 we are adopting the European LOLE standard result of 50%, and this is a slight increase from last year. On the basis that the new modelling is tending to increase the values, and seeking some temporal consistency, we recommend 60% for 2021/22. For comparison, in the 2019 All-Island Generation Capacity, a derating factor of 60% is also used[7], although of course for flows in the opposite direction.

[7] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Group-All-Island-Generation-Capacity-Statement-2019-2028.pdf

61. For France, the maximum 91% is similar in the Base Case and FES scenarios, whilst the minimum 50% is the 10GW French nuclear outage sensitivity. We are inclined towards the EU LOLE standard simulations giving 76% under the Base case assumptions. This compares with 70% recommended by us last year for 2023/24.

62. For Belgium, the maximum 88% is similar in the Base Case and FES scenarios, whilst the minimum 46% is the 10GW French nuclear outage sensitivity. We are inclined towards the EU LOLE standard simulations giving 69% under the Base case assumptions. This compares with 47% recommended by us last year for 2023/24.

63. For Germany, we agree that the link is implausible on current information for 2024/25.

64. For The Netherlands, the maximum 84% is similar in the Base Case and FES scenarios, whilst the minimum 48% is the 10GW French nuclear outage sensitivity. We are inclined towards the EU LOLE standard simulations giving 63% under the Base case assumptions. This compares with 37% recommended by us last year for 2023/24.

65. For Denmark, the maximum 80% only occurs in one scenario, whilst the minimum 45% is the 10GW French nuclear outage sensitivity. We are inclined towards the EU LOLE standard simulations giving 57% under the single applicable scenario assumptions. This compares with 35% recommended by us last year for 2023/24.

66. For Norway, the maximum 100% is similar in the Base Case and FES scenarios, whilst the minimum 91% is the 10GW French nuclear outage sensitivity. We are inclined towards the EU LOLE standard simulations giving 99% under the Base case assumptions. This compares with 97% recommended by us last year for 2023/24.

PTE Recommended Country De-rating Factors		
	2021/22	**2024/25**
Ireland	60%	50%
France		76%
Belgium		69%
The Netherlands		63%
Denmark		57%
Norway		99%

67. It should be emphasised that, as with previous years, these derating factors are based only upon economic flows and resource availabilities in an interconnected market that is working efficiently. It does not take into account technical reliabilities of the interconnections. BEIS has always considered making adjustments to the PTE recommendations for technical reliabilities. We wonder if this should still continue to be

the normal practice. There are concerns in particular that the new HVDC links may be less reliable, at least initially. International data[8] on HVDC suggest that outage rates may be around 7%. We therefore advise further consideration of the technical adjustment and how it should become explicitly part of the capacity procurement methodology in the future. This may have subtle and wider implications, however. Large offshore wind farms with HVDC links that are not part of the GB transmission network may also fall into this category of consideration, for example. They will, however, have low derating factors because of their intermittency and so a further technical adjustment may not be material. In undertaking an analysis, we are aware that National Grid ESO may have a conflict of interest in considering some of the interconnectors and may not be comfortable in determining their technical reliabilities. Nevertheless we think this is an important issue for further consideration.

New Recommendation 56: The Technical Reliability of HVDC links should be considered more fully and whether the technical reliability of interconnectors, and perhaps private links to large offshore wind farms, should become more explicitly part of the procurement methodology in future.

[8] CIGRE B4-137 (2018) A survey of the reliability of HVDC systems throughout the world during 2015-16. M.G. Bennett and N.S. Dhaliwall
ENTSOE (2018) Improving HVDC system reliability, ENTSOE Position Paper
https://www.entsoe.eu/news/2018/12/12/improving-hvdc-system-reliability/
ENTSOE (2019) Final Dissemination Workshop on HVDC Reliability ENTSOE Workshop
https://www.entsoe.eu/events/2019/05/14/final-dissemination-workshop-on-hvdcreliability/

Conclusion on Target Capacities

68. 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 also wish to express our appreciation of the constructive manner in which National Grid ESO and BEIS have engaged with the PTE.

    From this overall context of appreciation, we make the following procurement recommendations:

    For T-1, we accept the ECR recommendation of zero.

    For T-4, whilst we accept the analysis leading to a procurement of 41.6GW, as being coherent from the assumptions made pre COVID-19, we expect the assumptions post COVID-19 will need to be revised and we welcome the opportunity to re-consider the new evidence which will be presented in autumn 2020. We expect substantial uncertainty to remain in these considerations - a factor BEIS may wish to consider in the T-4 auction procurement.

Quality Assurance

69. Previously followed procedures continue to provide QA and these are closely aligned with BEIS's 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.

Annex 1: Progress on the PTE's Previous Recommendations

70. The PTE has always made Recommendations in its previous reports. Last year's (2019) PTE report made 10 new Recommendations, numbered from 42 to 51 (continuing on from the previous years' numbering). All these Recommendations, along with others raised by BEIS, Ofgem and National Grid ESO's internal post review/update process were considered by National Grid ESO. National Grid ESO undertakes a scoring process to decide which Recommendations can be taken forward. The results of this process are:

PTE 2019 Recommendations which led to development projects with the outcomes accepted and implemented	**PTE Comment**
No. 47/48. Register of embedded generators/storage installations. National Grid ESO supported DCUSA change proposal DCP350, which has been recommended for approval by DCUSA parties and is now awaiting Ofgem approval. Once approved NGESO will have access to the more granular data that Electralink collates for settlement purposes. NGESO says this will enable a development project to analyse this data.	It will be important to check that data quality is fit-for-purpose and that the capacities and availabilities (during stress periods) of installations of different technologies can be tracked. If the data is not fit-for-purpose then we would expect National Grid ESO to request that Ofgem instructs parties to adjust their data submissions. **It is vital that this change is approved and implemented swiftly to give National Grid ESO the data for an improved evidence-based analysis in the future.**
No. 43. Assess systematic upward bias in base case forecasts. National Grid ESO has presented to PTE, BEIS and Ofgem more up-to-date demand projections which show a trend of declining errors and periods of under forecasting. This improvement is explained by more focused efforts and application of new techniques in the light of the forecast accuracy incentive. This years' ECR provides a section (Annex A.1) on National Grid ESO's forecasting performance.	National Grid ESO's presentation, including its more recent projections, shows no systematic upward bias. We acknowledge the additional material included in this years' ECR on the demand forecasting performance. We note that it will be difficult to assess forecast performance in normal circumstances, given the considerable challenge of forecasting energy demand in the aftermath of Covid-19.
No. 51. Co-location/hybrid de-rating factor method. National Grid ESO's current modelling approach is to treat each sub-component separately and estimate the appropriate de-rating factor, which is ok where the sum of these does not exceed site	This is a complicated issue and one that currently does not appear to have a material impact. If this is shown to be case and there are few objections from CM parties, then we are content that this can be parked for now. However, if market

entry limits. However, where it does exceed, owners of such installations are unable to meet their capacity obligations. National Grid ESO has worked with its modelling consultants to modify their Unserved Energy Model (used for calculating de-rating of duration limited storage and variable renewables) such that can mitigate the impact of the site constraints prioritising intermittent, then convention generation with storage last. This has shown that the impact of the constraints only apply in a few cases. National Grid ESO says a further modification may be required if this is still considered material.	participants express concern, a pragmatic solution may have to be devised.

PTE 2019 Recommendations which were accepted and undertaken, but did not lead to implemented outcomes.	**PTE Comment**
No. 43. Assessment of availabilities for ageing generation. In the absence of forward-looking indicators and lack of clear trend in the data regarding availabilities of ageing plant National Grid ESO has decided no changes are required to it calculation based on the 7-year average.	This is reasonable. Low availabilities can be handled via non-delivery sensitivities.
No 46 (and 39). Black swan events and combined sensitivities. National Grid ESO revisited prior work (reported in ECR 2017) regarding a hybrid least-worst regret (LWR) approach which considered outlier cases but assigned them low probabilities. As before, National Grid ESO argued that such events with low probabilities had little effect but giving them near equal probability would mean that they always determine the LWR result. National Grid ESO argue that current sensitivity cases cover a reasonable level of risk consistent with LOLE targets.	Where the LOLE target is interpreted as a small and rare incidence of unserved energy then this approach is justifiable. We are not planning for the worst-case scenario, but rather considering reasonable risk in order to understand forward procurement of capacity. This does however raise the question as to who is planning for worst case scenario, a question that is reasonable in this current period of Covid-19. We are now in a black swan event and there may well be lessons to take from this disruption.
PTE 2019 Recommendations which were not taken forward but remain relevant.	**PTE Comment**
No. 44. Load shape evolution. Received a low score so not considered. Last year this was seen as a long-term issue.	The collapse in demand seen as result of social distancing rules to arrest the pandemic also shifted load the shape. Some are speculating that changes in behaviour (such as increased home-working) could shift the

	load shape for the longer term. This recommendation has been embedded in a more wide ranging **Recommendation 52** for this year.
No. 49. Economics of embedded generation. Received a low score largely due to lack of available data.	It is expected that in time the availability of the DNO data on embedded generation capacity and availabilities would enable a useful analysis of how embedded generation types are affected by market and regulatory changes.
No. 50. DSR and impact of changing network charging regimes. Received a low score largely due to lack of available data.	Addressing this recommendation is also contingent upon new sources of data become available to National Grid ESO. This is something which should be addressed by the Energy Data Taskforce. The implementation of DCP350 may help.
PTE Previous Recommendations Not Taken Forward	
No. 42. LOLE/EEU for small gens and duration limited storage	The issue of small generators is of increasing concern. A previous study by National Grid ESO indicated that the system reliability may be higher than the conventional modelling as large units get replaced by many smaller ones. This is something that should be re-evaluated in due course. Duration-limited storage has been addressed effectively.
No. 29. Scarcity pricing	This is less of a concern with the new modelling undertaken for interconnector flows. We suggest it is now withdrawn.

71. National Grid ESO assesses which recommendations to pursue, delay or, in effect, reject by using a multi-criteria scoring system[9]. This gathers a number of projects that have been suggested by National Grid ESO itself, BEIS and Ofgem as well as our recommendations and ranks these for action within limited resource and time constraints, according to subjectively awarded scores against the criteria of "Impact / Materiality", "Effort/Resource" and "Priority", with Priority being double-weighted.[10] BEIS consults the PTE on scores but the PTE is not involved in the decision-making process itself and therefore has little opportunity to assert its views at crucial decision points in determining the ranking.

[9] See Section 2.5 of the 2018 Electricity Capacity Report for full details.
[10] See Electricity Capacity Report Annex A.3 EMR/Capacity Assessment Development Projects Matrix.

Annex 2: Methodology for Procurement Recommendations and Emerging Concerns

72. The procurement methodology, which uses the Least Worst Regret (LWR) criterion, produces a capacity-to-secure which is deliberately cautious with respect to the uncertainties and risks in achieving the LOLE target of 3hrs. The LWR outcome is essentially determined by the most pessimistic and the most optimistic of the scenarios and sensitivities considered. This year the outcomes for the T-1 auction and the T-4 auction are determined by the Leading the Way and the Steady Progression scenarios (Figure 2 and Figure 4 of the ECR). In each auction the methodology recommends a capacity-to-secure that is higher than that required under the Base Case scenario, reflecting the caution inherent in this approach.

73. If the Secretary of State adopts the ECR recommendations for the T-4 auctions and on average the Base Case forecasts are correct, there will on average be excess capacity procured. This is, in itself, not unreasonable, given the asymmetric costs of VoLL and CoNE and the need to be cautious. We have recognised this risk aversion effect as a theoretical property of the LWR method for several years, but only recently as the T-4 auction results have translated to T-1 procurements, has the outcome evidence shown for the past two years that negative T-1 procurements have actually resulted from the modelling. Whether this requires adjusting the approach, if it looks like creating a persistently negative T-1 outcome, requires further investigation.

74. There is considerable uncertainty about the capacity required in four years' time, and the T-1 auction later allows errors in one direction to be corrected. The Secretary of State can decide to hold back some capacity from the T-4 auction for the T-1 auction; but for the last two years the amount held back turned out to be less than needed to create a positive T-1 target capacity recommendation from National Grid ESO.

75. It is notable, from Table 56 of the ECR, that it has been consistently cheaper for National Grid ESO to purchase capacity one year ahead rather than four years ahead. There may be many reasons for this, including changing market conditions, but if the liquidity of the T-1 auction is increasing, as well as the range of facilities being attracted to the T-1 auction, this is a further reason to re-consider the appropriate level of caution needed in the T-4 auctions.

76. The long-standing set aside commitment for T-1 auctions has now been formalised in legislation, The Electricity Capacity (Amendment etc.) (Coronavirus) Regulations 2020. Under these Regulations the Secretary of State must determine the T-1 auction set aside by applying a 95% confidence interval around the target capacity, and the auction capacity for the T-1 auction must be an amount greater or equal to 50% of the set aside. It is not clear in legislation how a 95% confidence interval is to be defined and used. We therefore suggest that it is timely to undertake a more thorough analysis of the uncertainty in the methodology, the consequent risks and their implications for an appropriately cautious, but not over cautious, determination of the capacity to procure.

New Recommendation 57: We recommend that National Grid ESO undertake a fundamental analysis of the sequential nature of the capacity procurement, taking account of the appropriate caution needed in relation to the quantifiable and unquantifiable uncertainties, risks and their consequent costs.

This publication is available from: www.gov.uk/government/publications/national-grid-eso-electricity-capacity-report-2020-findings-of-the-panel-of-technical-experts

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