# Panel of Technical Experts

## Final Report on National Grid's Electricity Capacity Report

July 2019



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# Contents

# Preliminary Comments & Summary 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 2018 with consideration of a number of the special projects being undertaken by National Grid ESO related to their modelling. These deliberations continued through the autumn and related mainly to interconnector de-rating and intermittent generation de-rating. By April and May 2019, the PTE were presented with the initial results from the modelling for the 2019 ECR.

3. The composition of the PTE changed during this period. In 2018, the PTE was Michael Grubb (chair), Goran Strbac, Andris Bankovskis, Derek Bunn and Guy Doyle. In 2019, the PTE members who prepared this report are Derek Bunn (chair), Guy Doyle and Lisa Waters.

4. In fulfilment of our role, we have scrutinised National Grid ESO's 2019 Electricity Capacity Report on the target capacity for the proposed T-1 Auction for delivery year 2020/21, the provisional T-3 Auction for the year commencing 2022/23 and the T-4 Auction for the year commencing 2023/24, and this document presents our conclusions.

5. Through our previous reports (2014-2018), the PTE has made 41 recommendations in total (of which 6 were from 2018) 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 recommendations for future work.

6. The PTE has engaged in relevant discussions with National Grid ESO, BEIS and Ofgem during the process of National Grid ESO formulating the Electricity Capacity Report 2019 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. We are pleased to endorse the substantially different approach to European power flow modelling which leads to a new approach for determining the interconnector de-rating factors. We fully agree that this new approach is preferable to the approach of using ranges between historical and forward-looking estimates, as produced in 2018.

8. We agreed on the sensitivities that went in to the estimation and the application in 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.
- For T-3, whilst we accept the analysis leading to a procurement of 45.4 GW, we note the systematic demand over forecasting bias of 0.8GW during recent years, which has not previously been taken into account, and therefore suggest a de-biased adjustment to **44.6GW.**
- For T-4, whilst we accept the analysis leading to a procurement of 44.7GW, we note the systematic demand over forecasting bias of 0.8GW during recent years, which has not previously been taken into account, and therefore suggest a de-biased adjustment to **43.9GW.**

10. We raise a number of concerns, again, about the lack of data on embedded generation capacities and suggest that, with greater clarity on data, non-delivery estimates could be revised by BEIS and ESO later this year. Furthermore, amongst our recommendations is an initiative to motivate the DNOs to create a register of connected embedded facilities, and the PTE is willing to help progress this through raising a DCUSA modification if appropriate.

11. We give our recommendations for interconnector de-rating factors in the following table:

| **Summary of Table 4: PTE Recommended Country De-rating Factors** | | | |
|---|---|---|---|
| | **20/21** | **22/23** | **23/24** |
| Ireland | | 57 | 45 |
| France | 94 | 76 | 70 |
| Belgium | 84 | 59 | 47 |
| Netherlands | | 51 | 37 |
| Norway | | 97 | 97 |
| Denmark | | | 35 |

12. Overall we were pleased with the process of engagement with National Grid and BEIS and thank them for their extensive efforts to develop clear and timely analysis and address many of the technical issues we raised. During the course of this engagement, we identified some wider methodological issues which reflect the rapidly changing nature of the electricity system and have been pleased to advise on these during the course of the current 5-year review.

# Recommendations

13. The new recommendations in our report are listed below. (The numbering follows on from the 41 recommendations in previous PTE reports).

**New Recommendation 42:** National Grid ESO should undertake a re-evaluation of the sensitivity of the LOLE and EUE calculations to the growth in smaller generators, also with regard to the technologies with possible duration-limited performance.

**New Recommendation 43:** National Grid ESO take explicit and credible steps to explain and de-bias demand forecasts so that PTE recommended adjustments will not be necessary.

**New Recommendation 44:** National Grid ESO provide a more explicit analysis of the potential load shape evolutions and their implications for peak demand.

**New Recommendation 45:** National Grid ESO provide an explicit assessment of what an ageing and renewing fleet implies for the extrapolation possible trends from historical availabilities.

**New Recommendation 46:** National Grid ESO and BEIS should re-consider how including some Black Swan and Combined Sensitivities could be undertaken to reflect the changing market circumstances.

**New Recommendation 47:** National Grid ESO, BEIS and Ofgem should urgently consider the most expedient way to motivate a comprehensive DNO compiled register of embedded connection capacities.

**New Recommendation 48:** In order to allow more effective monitoring of early /non-delivery we urgently recommend that a register of embedded generators is established, through Recommendation 47, which shows the status of connections and expected commissioning dates by plant.

**New Recommendation 49:** National Grid ESO should build upon their previous economic modelling of the viability of embedded generators to provide a more comprehensive view on potential embedded non-delivery.

**New Recommendation 50:** National Grid ESO, BEIS and Ofgem should investigate the economic drivers of the DSR sector and distributional impacts of Ofgem's proposed changes to the charging regime.

**New Recommendation 51:** National Grid ESO will need to develop a methodology for dealing with co-located facilities.

# 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's analysis to inform Capacity Market decisions was published in June 2014. This is the PTE's sixth report, focused on the recommended capacity to secure for the 2023/24 T-4 auction, the provisional 2022/23 T-3 auction (since the 2023/24 T-4 auction was not held) as well as the recommended capacity to secure for the 2020/21 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 membership of the PTE changed in spring 2019 and whilst the initial deliberations in autumn 2018 were undertaken by Michael Grubb (chair), Goran Strbac, Andris Bankovskis, Derek Bunn and Guy Doyle, this report has been prepared for BEIS by three members of the new Panel:

    a. Professor Derek Bunn (chair)

    b. Dr Guy Doyle

    c. 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,

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

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 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 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, BEIS and Ofgem several times during the autumn 2018 to discuss development projects and the production plan for 2019. Then, in 2019, meetings were held in April and May, during which presentations of the results were made by National Grid ESO and the PTE had an opportunity to ask questions and make comments. Subsequent to the meetings, the PTE provided various 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 data and DSR data

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 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 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 and Ofgem and the collective judgement and information of its authors. 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 the Modelling and Results

## Introduction and context

26. As in its previous ECRs, National Grid 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.

27. The technology mix and market structure has changed substantially since the beginning of EMR. With smaller generators becoming widespread, consumers also generating, new storage facilities and substantial intermittent resources becoming significant, the analytical challenges are evolving and increasingly different to how the modelling was originally envisaged. National Grid ESO have responded through a series of development projects, e.g. on storage and intermittency, and we believe that the modelling approach has remained fit for purpose in the context of these changes. Nevertheless, transparent data on the behaviour of distribution connected resources remains a major and increasing limitation. We note that recent access to the Electralink data on embedded generator outputs has been useful, but uncertainty on capacities remain. This point is discussed more in the Generation section below. We also recall that an initial study on the effect of many smaller generators on the LOLE[2] and EUE[3] calculations was undertaken by National Grid a couple of years ago, but we now recommend that this be revisited, also with regard to technologies with possible duration-limited performance.

28. **New Recommendation 42: National Grid ESO should undertake a re-evaluation of the sensitivity of the LOLE and EUE calculations to the growth in smaller generators, also with regard to the technologies with possible duration-limited performance.**

## Demand forecasting

29. 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.

30. Although the four FES scenarios provide a useful longer-term overview and way of thinking about the energy transition, their role in the actual ECR calculations is not paramount. The crucial methodological element for the assessment of the capacity to secure is the short-term Base Case, together with its sensitivities. Thus, in PTE 2018, Recommendation 36 was for a more comprehensive focus on the derivation of the BASE Case. We are pleased and grateful to see that ECR2019 includes this. The Base Case is a bottom-up, feedforward projection of current trends supplemented with market

[2] Loss of Load Expectation
[3] Expected Unserved Energy

information. We therefore do not offer a critique on the four FES scenarios, but focus our comments on the Base Case and its Sensitivities.

31. ESO estimate underlying demand (I.e. total demand) as opposed to transmission level demand. This is unrestricted which means ESO have added back DSR to restricted ACS demand, since DSR can participate in the CM and therefore needs to be included in the demand. This requires data on embedded generation, as well as estimates of consumer demand-side response, and we discuss these in the Generation section below.

32. Whilst we are reassured from the ECR and discussions with ESO that all demand relevant factors are being considered, and we are comfortable with the approach, the question of forecasting model calibration still remains. We therefore requested data on outturn accuracy from ESO. Similar data was provided to Ofgem for their state of the energy market analysis and as part of the demand forecasting incentive scheme. We are informed by ESO that the values below are more accurate than those reported in the Ofgem 2018 State of the Energy Market Report.[4] They refer to winter ahead ACS peaks. T-4 forecast errors are expected to be larger.

**Table 1: Ex Post Demand Forecasting Accuracy. ACS Restricted National Demand – Comparison of winter ahead projections against outturn values (GW): Source National Grid ESO as provide to Ofgem**

| Winter | FES Year | ACS Restricted National Demand Out-Turn | Base View: ACS Restricted National Demand (projected) | Slow Progression ACS Restricted National Demand (projected) | Combined Base/SP % Diff. | Combined Base/SP Diff GW |
|---|---|---|---|---|---|---|
| 2008/09 | | 57.4 | 59.3 | | 3.3% | 1.9 |
| 2009/10 | | 57.2 | 55.5 | | -3.3% | -1.7 |
| 2010/11 | SYS 10 | 57.1 | 57.0 | 57.0 | -0.2% | -0.1 |
| 2011/12 | SYS 11 | 55.4 | 57.5 | 57.5 | 3.8% | 2.1 |
| 2012/13 | FES 12 | 54.7 | | 55.4 | 1.3% | 0.7 |
| 2013/14 | FES 13 | 53.7 | | 55.3 | 3.0% | 1.6 |
| 2014/15 | FES 14 | 53.0 | | 53.3 | 0.6% | 0.3 |
| 2015/16 | FES 15 | 51.1 | | 53.2 | 4.1% | 2.1 |
| 2016/17 | FES 16 | 50.3 | 51.1 | 51.1 | 1.6% | 0.8 |
| 2017/18 | FES 17 | 49.4 | 50.1 | 50.1 | 1.4% | 0.7 |
| Mean Diff. | | | | | **1.6%** | **0.8** |

[4] www.ofgem.gov.uk/system/files/docs/2018/10/state_of_the_energy_market_report_2018.pdf

33. The above data shows a systematic bias in over-forecasting demand, on average by 800MW over the past 10 years, with the last 7 years all being positive. Whilst it is possible that in future, with Ofgem's incentive scheme[5] for improving demand forecasting accuracy, that this bias may be reduced, there is no evidence yet to suggest future accuracy will be better than the historical. The existence of an incentive scheme does not guarantee that bias will be reduced and we observe that the rewards and penalties are a maximum of plus or minus £3M. This does not appear to be material in the context of the various system-wide benefits of over-procurement to the ESO. The incentive scheme linked with EMR has only been implemented for recent years, not the 10 years in the above data. Nevertheless, since FES14, the average error has been close to 1GW, since FES 15, it has been 1.2GW and over the past two years has been 0.75GW. From a factual basis therefore, we must reflect this evidence on systematic bias and cannot presume that the existence of the demand incentive scheme will remedy it fully from now onwards. Our view, therefore, is that procurements, as recommended by National Grid ESO in ECR 2019, should be reduced by 800MW to correct for this systematic bias.

34. In the future we recommend that the ECR gives explicit details if National Grid ESO claim to have corrected for this systematic bias themselves as part of the final Base Case estimation. This would involve a clear explanation of the source(s) of this historical bias and why it has been eliminated going forward. We note that ESO has a license obligation[6] to write annually to the Authority, at the same time it publishes the Electricity Capacity Report, to set out the steps it has taken to improve its Peak System Demand Forecast. It would be helpful to both Ofgem and the PTE if ESO considered whether a draft of this deliverable, or a section in ECR, explicitly addressed remedies for historical bias and this analysis should be to be produced in time for the PTE to formulate is recommendations.

35. **New Recommendation 43: National Grid ESO take explicit and credible steps to explain and de-bias demand forecasts so that PTE recommended adjustments will not be necessary.**

36. In several places the report refers to the changing daily load profile as storage, demand-side actions, EV charging, electrification of heat, etc., may be moving and/or moderating the timing and scale of peak occurrences. Furthermore, future changes to triad-avoidance incentives to embedded generators, and potentially customers, needs to be considered. The ECR does not provide an explicit description of the daily load profile changes over time which are implicit in the peak load forecasts. The equivalent report in support of the Irish capacity procurement[7] has a short section on load profiles and we suggest this would be a useful inclusion the GB ECR going forward.

37. **New Recommendation 44: National Grid ESO provide a more explicit analysis of the potential load shape evolutions and their implications for peak demand.**

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5 https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/decision_on_revenue_outputs_and_incentives_for_nget_plcs_roles_in_electricity_market_reform_0.pdf

6 Special Condition 4L.13 (Financial incentives on EMR) of National Grid Electricity Transmission plc's Electricity Transmission Licence

7 http://www.eirgridgroup.com/site-files/library/EirGrid/Generation_Capacity_Statement_2018.pdf

# Generation Forecasting and De-Rating factors

## Station Availability

38. The National Grid ESO measures station availability with de-rating factors which reflect historic performance of the existing fleet of transmission connected generation. The suspension of the Capacity Market in 2018 will have created financial hardship for the impacted generators who would have been expecting Capacity Market income over the past 10 months. It is difficult to know if this has had a material impact on the reliability of existing generation, but the PTE are aware that some generators have said that they have had to cancel and/or delay maintenance. This may impact reliability this coming winter, and depending on the timing of the restart of the Capacity Market, the availability of back payments and time to get delayed maintenance done, there could be an impact on reliability for winter 2020/21. The National Grid ESO acknowledges that reliability may be impacted by maintenance issues, but has no specific data on how much this could impact. We suggest that BEIS actively monitors this issue and may want to adjust the capacity to procure according to the latest information as it becomes available in Summer 2019.

39. National Grid ESO makes a number of assumptions around non-delivery such as extended nuclear outages or unproven DSR failing to materialise. Their low plant availability sensitivities for 2020/21 have a minor impact, but not in 2022/23 and 2023/24. For nuclear they assume availability reduces from 81% to 74% and for CCGTs from 90% to 87%, based on one standard deviation below the mean observable figures, but rightly note that historic data may not be the most robust way to asses future availability of specific plant types, especially with an aging fleet of large power stations (transmission connected). We suggest some commentary on trends from the data, distinct from simple historical averages. These concerns may also deserve further consideration in the autumn by BEIS.

40. **New Recommendation 45: National Grid ESO provide an explicit assessment of what an ageing and renewing fleet implies for the extrapolation possible trends from historical availabilities**

## Black Swan Events & Combined Sensitivities

41. A systematic fault across any technology type is generally regarded as a type of "Black Swan" event. The AGR nuclear fleet is aging, operating under extended life permissions, and two stations, Hunterston B Power Station in Ayrshire and Dungeness B in Kent, have experienced extended outages over the last year. The PTE notes that structural integrity of the graphite core has been cited as the ultimate limiting factor to the lifetime of the AGR reactors. The PTE is concerned about the potential for common-mode faults, as evident with the French nuclear fleet, and as seen in CCGT outages in 2018 (noted in the PTE report of 2018[8]).

42. The ECR notes that the coincident failures of generating units has been raised by a number of parties with National Grid ESO, but that the lack of data makes it difficult to model such events. The same is true when two or more external factors arise at the

[8] Panel of Technical Experts – Independent Report on National Grid's Electricity Capacity Report - Para 60

same time, such as cold weather with a fuel supply event. These events have a low probability but high impact. Last year the National Grid ESO's academic advisers said that such events should not be included in the LWR approach.

43. Last year the PTE recommended that National Grid ESO undertake a historic analysis to determine the extent to which stress events on the network have been due to combined events and to asses whether such combinations may arise again (Recommendation 39). National Grid ESO has not analysed the causes of historical stress events e.g. whether combinations of events caused system stress, noting the lack of historical stress events to analyse.

44. The PTE continues to agree that sensitivities around Black Swan and combined events would be difficult to model in a robust manner. However, in light of the recent nuclear outages, the age of the plant on the system and possible changes in weather patterns, we suggest a re-review of whether and how Black Swan event sensitivities or combined events should be considered going forward.

45. **New Recommendation 46: National Grid ESO and BEIS should re-consider how including some Black Swan and Combined Sensitivities could be undertaken to reflect the changing market circumstances.**

## Embedded Generation

46. PTE previously recommended (in 2017 and 2018) that National Grid ESO sought more robust data on embedded generation to inform their forecasting. Despite work with Electralink, National Grid ESO appear to have made very little progress and PTE remains concerned and disappointed with the lack of progress in this area. ESO have obtained the best data available from Electralink on output per site but lack the corresponding capacity figures which Electralink do not hold. Without the necessary data it is not possible to assess the materiality of many uncertainties around embedded generation availability to the ECR's conclusions.

47. The PTE recognises, as does the National Grid ESO, that embedded generation, as well as Demand Side Response (DSR), in GB's energy market now plays a major and increasing role in system security. Most of the new build capacity secured in T-4 auctions since the start of the Capacity Market has been embedded. In 2016, circa 4GW[9] of capacity procured was new build generation and unproven DSR, for delivery from 2020 up to 2035. How this will perform impacts LOLE.

48. The business plans of investors in embedded generators and DSR providers may have been impacted by a variety of factors, not least the suspension of the Capacity Market payments from autumn 2018. In this context, it is a concern that the reporting under the Capacity Market rules may not be as robust as it should be, and that some CMU holders may be in difficulties. The PTE considers that secondary trading of Capacity Market agreements would help, but understands that transactions are awkward and we welcome Ofgem's work to refine the Rules to facilitate trading. Thus, there is uncertainty on how much capacity holding agreements for 2020 will be delivered late or not

[9] T-4 2016 Auction Results - https://www.emrdeliverybody.com/Capacity%20Markets%20Document%20Library/Final%20Results%20Report%20-%20T-4%202016.pdf

delivered at all. BEIS should have more information on delivery in 2018/19 once the window for Satisfactory Performance Days data ends in the summer. If this survey data indicates a material change in availability, BEIS should adjust the target capacities ahead of the auctions to procure accordingly.

49. One feasible solution to provide National Grid ESO with robust data on embedded generation delivery is if the Distribution Network Owners (DNOs) were to report on booked and live connections on their networks. PTE believes that as a minimum each DNO should be required to produce a register of embedded generation as a matter of urgency. We are aware that this is being considered by both the Open Networks Project and the Energy Data Taskforce, but progress may be too slow to aid near term ECR reports. It is unclear to the PTE what the barriers to collating the data are, as National Grid ESO has managed to operate the Transmission Entry Capacity (TEC) register for many years. It may be more expedient to progress this matter through a DCUSA modification proposal, and PTE would be willing to raise it, if Ofgem and BEIS considers this appropriate.

50. **New Recommendation 47: National Grid ESO, BEIS and Ofgem should urgently consider the most expedient way to motivate a comprehensive DNO compiled register of embedded connection capacities.**

## Over Delivery of Generation

51. Because smaller plants can be built faster than the 4 years between the auction and the Capacity Market delivery year, the PTE is aware that some developers with longer term agreements have built early, allowing them to put plant into the T-1 auction, the year before their T-4 agreements start. There seems to be no downside for customers from such accelerated behaviour, but the structure of the Capacity Market registers and the lack of robust information on embedded generation means that this over delivery may not be captured by the National Grid ESO.

52. **New Recommendation 48: In order to allow more effective monitoring of early /non-delivery we urgently recommend that a register of embedded generators is established, through Recommendation 47, which shows the status of connections and expected commissioning dates by plant.**

## Non-Delivery of Generation

53. National Grid ESO have always undertaken a careful economic and technical analysis of large plant such as coal and gas with respect to their prospects of early retirement, but there may also be significant volumes of embedded generation which could shut early due to changes in policy such as the implementation of the Medium Combustion Plant Directive (MCPD) and Ofgem's proposed changes to the charging regime. Some of this generation will be difficult to identify as it sits behind customers' meters, but permitting data from the Environment Agency may be informative, as would a register of all embedded generation, as proposed above. National Grid ESO undertook some careful economic modelling of selected embedded facilities previously, following the proposed withdrawal of some of the Triad embedded benefits, but we recommend this modelling be extended to be as comprehensive as possible.

54. **New Recommendation 49: National Grid ESO should build upon their previous economic modelling of the viability of embedded generators to provide a more comprehensive view on potential embedded non-delivery.**

55. The PTE agreed with the National Grid ESO that renewable plant non-delivery, to reflect slippage in non-Capacity Market plants being connected, is captured in the range of FES scenarios and the Base Case. However, the scale of late delivery would be better understood if it was more closely monitored via an embedded generation register, as recommended above.

56. It is challenging for the National Grid ESO to know how much DSR is load shedding and how much relates to on-site generation, though they have indicated that about 50% of Triad avoidance may be from alternative supplies. PTE notes that some of the options under Ofgem's charging reviews could potentially alter the economics of both true DSR and on-site generation. The PTE has discussed this with the National Grid ESO who note that they have modelled the potential impact of changes to Triad charging arrangements (where the benefit to embedded plant is substantially reduced from April 2020), but not the wider distributional impacts of Ofgem's charging review, notably the impact on DSR.

57. The ECR forecasts DSR to be relatively stable for the next few years, but post 2020 there is significant divergence in the scenarios' pathways, with all showing increases. The most significant determinant is decarbonisation, but the modelling relies on the investments being either income generating or cost saving. Currently the main cost saving is avoided network charges and peak power prices, but changes in the policy background may make assessing the economics of these investments more difficult for customers and a better understanding of the economics of the DSR market would enhance understanding of this sector.

58. The PTE has previously noted that demand elasticity, applied to the ASC peak underlying the demand forecasts, should be examined (Recommendation 38). In this year's ECR the National Grid ESO considers the impact of smart meters, smart technology and smart metering which could impact peak demand. However, the impact of altering the charging regime more broadly could be as, or even more, material than these "smart" developments. It is possible that while some domestic behaviour changes, the opposite effect is seen from industrial and commercial sectors.

59. The PTE would expect that Ofgem's analysis of its proposed changes to the charging regime will provide enough detail on the expected impacts on different groups of customers to inform National Grid ESO's modelling of likely changes in customer decisions around both voluntary DSR (the current Triad effect) and contracted DSR under the Capacity Market.

60. **New Recommendation 50: National Grid ESO, BEIS and Ofgem should investigate the economic drivers of the DSR sector and distributional impacts of Ofgem's proposed changes to the charging regime.**

## Co-location

61. The PTE notes the work that is ongoing around the treatment of co-located generation across the GB market. The National Grid ESO is looking at the main options for co-location, and we note that a CUSC modification[10] has also been raised to consider the charging arrangements for such sites.

62. **New Recommendation 51: National Grid ESO will need to develop a methodology for dealing with co-located facilities.**

## Misalignment of Plant Capacity with Export Capacity

63. The National Grid ESO notes that some CMUs (Capacity Market Units) have a greater connection capacity than their TEC (Transmission Entry Capacity). Thus, when de-rated, their obligated capacity can be equal to their TEC. The modelling is based on TEC and so mitigates against the risk of the Capacity Market rules over stating capacity. However, the PTE note that this may also be a risk for embedded Capacity Market plant that trades, as a site picking up an obligation is required to demonstrate it can deliver that obligation (the de-rated capacity). This reinforces the need to have an embedded capacity register, as recommended above, that shows both the plant capacity and the export rights so that the impact of obligation trading can be assessed.

# Interconnector Flows and De-Rating factors

64. PTE has been asked by BEIS to recommend specific De-rating Factors (DRF) for the power available to GB interconnectors at times of GB need, taking account of the modelling results presented by National Grid ESO.

## Approach

65. The requirement of the interconnection analysis in the ECR is to estimate a range of de-rating factors for each interconnected country for the auction years.

66. In previous years National Grid ESO have looked at a combination of backward- and forward-looking analysis to provide the ranges. However, the historical values have been regarded as setting unrealistic levels. Furthermore, since the computation of interconnector de-rating factors is incremental and the de-ratings will change over time according to the volume of interconnection capacity, historical comparisons can be misleading. This year, therefore, the approach relies solely on the forward modelling approach. The range now comes from the FES scenarios included in the forward modelling. We consider this new methodology to be more appropriate than that of previous years.

67. As in last year's ECR, National Grid ESO has used the BID3 model developed by Poyry. European electricity demand and supply are modelled on an hourly basis (now across

[10] CMP316: TNUoS Arrangements for Co-located Generation Sites

11 countries covering most of Western Europe) at times of system stress in a way that captures the interdependencies influencing the reliability of the interconnectors (from six countries) to provide imports to GB. A consistent set of weather data is applied, and all four FES scenarios are simulated as well as the base case. For each auction year the model has been run for the 90 hours with the largest deficits of GB demand minus GB generation in order to represent the required 3-hour LOLE target. The main output of the model is a set of de-rating factors for each interconnected country for each scenario. As check on the robustness of the results, a second set of results was calculated for 30 hours with the largest deficits.

68. The model takes account of between-country interconnection constraints but does not consider within-country interconnection constraints. Strategic reserves are not included since data is poor and they are mainly designed for post market loss of load mitigation rather than active participation in the market. The model also does not factor in constraints on the GB import side or technical availability constraints (for forced and scheduled outages/deratings), as these corrections are applied later at the interconnector project level.

## Demand/supply balance and capability factors

69. This year, the modelling reported a measure of each interconnected countries' own demand/supply balance during the 90-hour GB stress periods. The ECR refers to this as the capability factor, defined as the ratio of within-country excess of generation over demand to the interconnection capacity to GB, expressed as a percentage in Table 2 below. This shows that, except for Norway, the capability factors are well below the interconnection capacity. The values are also generally well below the calculated de-rating factors, except for Norway and Ireland. Ireland has a substantial amount of legacy gas and coal plant remunerated under its own CRM. A low capability factors versus the de-rating implies that much of the supply for export to GB transits the country in question.

**Table 2: Projected generation surplus as share of national interconnector capacity (%)**

| | **2020** | **2022** | **2023** |
|---|---|---|---|
| Ireland | N/C | 88 | 55 |
| France | 67 | 45 | 47 |
| Belgium | 1 | 0 | 0 |
| Netherlands | N/C | 7 | 7 |
| Norway | N/A | 100 | 100 |
| Denmark | N/A | 9 | 9 |

N/C = not calculated, N/A = not applicable

70. Interestingly, this year's ECR provides a chart (ECR Figure 18) showing the surplus generation for France, Belgium, Netherlands and Germany (the latter not a direct

exporter to GB) which shows a rapidly deteriorating supply balance in the early 2020s. Averaging across the four FES scenarios and Base case shows the generation surplus over demand for these four countries falling from 5.1GW in 2020/21 to 1GW and 0.1GW in 2022/23 and 2023/24, respectively. This reflects the expected closures of legacy fossil and nuclear plant across these countries.

71. This picture of tightening demand/supply position in Europe – at least during the GB stress periods comes at a time when interconnection capacity is also set to increase.

72. Furthermore, if the UK leaves the EU without a deal, it is likely that it will lose access to the coupled intraday markets. This may increase the friction in trading.

73. The PTE acknowledges the enhancements made to the interconnector modelling and agrees that the 90-hour standard provides the appropriate reference for calculating the country de-rating factors, except in the case of Ireland. For Ireland, our preference is to use the values generated from running the most stressed 30-hours, because Ireland is the only country where the 30-hour case gives a consistently higher value than the 90-hour runs, and unlike other countries its capability factor exceeds the de-ratings factors. This appears to indicate that under scarcity conditions extra facilities become operational and able to export. This may not be the case in future capacity assessments and for a small country like Ireland, only interconnected to GB, it is likely that future derating factors may be more volatile than those related to continental Europe.

## Results

74. Table 3 reproduces the final Table in the ECR section on Interconnectors, showing the range of de-rating values for the three auction years, along with the de-rating values agreed in the CM agreements already awarded for Ireland, France and the Netherlands.

**Table 3: Derating factor ranges by country**

| Country | Delivery year | Contracted | Low | High |
|---|---|---|---|---|
| Ireland | Contracted 2020/21 | 26 | | |
| | 2022/23* | | 52 | 66 |
| | 2023/24* | | 39 | 52 |
| France | Contracted 2020/21 | 60 | | |
| | 2020/21 | | 88 | 99 |
| | 2022/23 | | 66 | 81 |
| | 2023/24 | | 57 | 79 |
| Belgium | 2020/21 | | 75 | 98 |
| | 2022/23 | | 52 | 65 |
| | 2023/24 | | 38 | 56 |
| Netherlands | Contracted 2020/21 | 74 | | |
| | 2022/23 | | 44 | 55 |
| | 2023/24 | | 30 | 44 |
| Norway | 2022/23 | | 93 | 99 |
| | 2023/24 | | 95 | 99 |
| Denmark | 2023/24 | | 35 | 35 |

* Values calculated on 30-hours instead of 90-hours.

Source: NG ESO, ECR 2019

75. The main features to note from Table 3 are:

- Only Norway has a high and stable de-rating factor – which reflects its strong demand/supply position.
- All the other countries see de-rating factors falling through time.

- Most countries have a range which spans the 50% mark.
- Ireland is no longer the exception with a very low de-rating factor.
- There is considerable uncertainty with most countries seeing a range over 10 percentage points across the FES scenarios.
- The contracted de-rating factors in the 2020/21 delivery year show no consistent pattern versus the currently modelled values, with Ireland and France awards appearing under-valued while Netherlands is over-valued.

76. Whilst National Grid ESO have been obliged to provide a range, their range shows the maximum disparity from the scenarios. This is a different perspective from previous years, in which the range was defined from two different methodologies: forward modelling and historical. Now we are only using the forward looking method, under 4 FES scenarios and the Base Case. The ECR also computes the Average de-rating factor across the four FES scenarios and the Base Case. We consider this to be the best expectation. We therefore recommend:

**Table 4: PTE Recommended Country De-rating Factors**

| | **20/21** | **22/23** | **23/24** |
|---|---|---|---|
| Ireland | | 57 | 45 |
| France | 94 | 76 | 70 |
| Belgium | 84 | 59 | 47 |
| Netherlands | | 51 | 37 |
| Norway | | 97 | 97 |
| Denmark | | | 35 |

# Conclusion on Target Capacities

77. 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.

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

- For T-1, we accept the ECR recommendation of zero.
- For T-3, whilst we accept the analysis leading to a procurement of 45.4GW, we note the systematic demand over forecasting bias of 0.8GW during recent years, which has not previously been taken into account, and therefore suggest a de-biasing adjustment to **44.6GW.**
- For T-4, whilst we accept the analysis leading to a procurement of 44.7GW, we note the systematic demand over forecasting bias of 0.8GW during recent years, which has not previously been taken into account, and therefore suggest a de-biasing adjustment to **43.9GW**

# Quality Assurance

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

The PTE has always made a number of recommendations in its previous reports. Last year's (2018) PTE report made 6 new recommendations, numbered from 36 to 41 (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 in the project evaluation, whereby all recommendations received by National Grid ESO are scored by National Grid ESO allowed 3 of these proposals to be taken forward. These were:

| **PTE 2018 Recommendations Accepted** | **PTE Comment** |
|---|---|
| **Recommendation 36:** We recommend full and transparent disclosure of the construction of NG's Base Case in the ECR, given that it represents NG's view rather than that the whole industry as represented in the FESs and plays a dominant role in the analysis. | **Acted upon and completed.** |
| **Recommendation 37:** In view of the issues in gathering data necessary for assessing national energy security requirements, BEIS, NG and Ofgem should urgently consider whether and when an information strategy might be required. | **Acted upon and ongoing.**<br><br>This action has been led by BEIS. |
| **Recommendation 40:** For informing next year's auction, NG should review the impact of set aside strategic reserves in continental Europe on interconnector contribution to security of supply, and if significant, include this within the 2019 interconnector DRF assessment. | **Acted upon and completed.** |

The 2 PTE 2018 Recommendations that were not accepted or deferred were as follows:

| **PTE 2018 Recommendations Not Accepted** | **PTE Comment** |
|---|---|
| **Recommendation 38:** NG should investigate the evidence for selecting a wider sensitivity band for demand outturns for overall demand both using historical data and its own FES modelling, to confirm that its current approach is appropriate. | Partially achieved with a larger demand range through the FES scenarios. |

| | |
|---|---|
| **Recommendation 39 (includes old 32):** In due course, NG should undertake a historical analysis to determine the extent to which stress events on its network have been due to combined events and to assess whether such combinations might arise again. The initial focus could be on station outages, using the detailed unit data available from REMIT process. This could for example examine the outages in gas stations experienced during the "beast from the East" on 1 March 2018 | Not progressed because of a lack of stress events. |
| **Recommendation 41:** Following the publication of this year's ECR and PTE Report, we recommend that the PTE should review of all its previous recommendations together with BEIS and NG in order to reduce the number and prioritise the most important of these. | No progressed as a consequence of the re-procurement of the PTE during 2018/19. |
| **PTE Previous Recommendations Not Accepted and Not Withdrawn** | |
| **Recommendation 30:** National Grid should consider taking a more pro-active role in informing the public about the issues in maintaining security of electricity supply, including the nature of risk and probability, and associated trade-offs. Perhaps this could be co-ordinated through the Energy Networks Association (ENA) or code group with support from Energy UK and Association of Distributed Energy (ADE). | PTE still considers this to be a worthwhile activity. |
| **Recommendation 35:** We are keen that National Grid consider again our previous Recommendation 16 but broadened to include consideration of the range of additional forms of 'latent capacity' (such as various possible responses of DNOs to demand reduction requests). | PTE may develop a further Recommendation next year to include this in a wider consideration of the BEIS and ESO opportunities to adjust advance procurements and take real-time actions to mitigate potential supply shortfalls. |

National Grid ESO assess which recommendations to pursue, delay or in effect, reject by using a multi-criteria scoring system[11]. This gathers a number of projects that have been suggested by National Grid itself, BEIS and Ofgem as well as our recommendations and orders these for action within a limited resource envelope according to subjectively awarded scores against the criteria of "Impact / Materiality", "Effort/Resource" and "Priority", with Priority being double-

[11] See Section 2.5 of the 2018 Electricity Capacity Report for full details.

weighted.[12] BEIS consulted the PTE on scores but the PTE is not involved in the decision-making process itself and therefore has no meaningful opportunity to assert its views at crucial decision points.

[12] See Electricity Capacity Report Annex A.3 EMR/Capacity Assessment Development Projects Matrix.

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