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MEMO

TO: Kevin Hannafin (Viridian)
DATE: 5 October 2016
FROM: George Anstey; Graham Shuttleworth (NERA)
SUBJECT: Derating Methodologies for Interconnectors: I-SEM

1. Introduction

Viridian asked NERA to comment briefly on the SEM Committee's Consultation on Interconnector De-rating produced by ESP Consulting.[1] This memorandum provides our initial views and proceeds as follows:

- Section 2 provides a brief overview of the methodology and explains that the level of detail in the Consultation paper makes it difficult for market participants to appraise its results;
- Section 3 explains that ESP's assumptions about how power flows will respond to the relative supply and demand balance in BETTA and I-SEM overstate the availability of the Moyle interconnector and EWIC;
- Section 4 explains how ESP's approach understates the frequency of scarcity events in Ireland and GB because it incorrectly assumes that wind and temperatures are uncorrelated *at peak times*;
- Section 5 explains that ESP relies upon a supply and demand forecast that is not a reliable basis for forecasting scarcity in GB; and
- Section 6 explains how ESP is overstating the availability of the interconnectors at time of system scarcity in Ireland, by excluding periods of prolonged outages on the Moyle interconnector and EWIC.

Given the size of the I-SEM market, with peak demand of 7 GW or less,[2] and given that interconnector capacity comprises around 15 per cent of peak demand, it is important for security of supply that the SEM-Committee sets de-rating factors for interconnectors which do not overstate their contribution to potential supply at times of system stress. To give market participants confidence that its results truly reflect the interconnectors' likely contribution, ESP would have to present a much fuller description of its assumptions, methods and results.

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1 ESP (2016), *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016.

2 Eirgrid's *All-Island Generation Capacity Statement 2016-2025* shows ACS peak demand in 2014/15 of around 4.9 GW for Ireland (Figure 2-5) and 1.7 GW for Northern Ireland (Figure 2-8).

2. The Proposed Methodology is Not Transparent and May Overstate the Availability of the Interconnectors

The Consultation sets out a proposed method for de-rating the nameplate capacity for the two interconnectors between Great Britain and Ireland for the purpose of competing in the proposed Capacity Remuneration Mechanism (CRM). ESP argues in the Consultation that changes in the I-SEM and BETTA limit the relevance of historical data and prevent it from effectively calibrating any forward-looking model of market prices.[3] Accordingly, ESP's proposed methodology relies on comparisons of physical demand and supply, using random draws from assumed distributions for "temperature, SEM and GB demand, SEM and GB wind and the heavily variable element of the GB operational reserve requirement."[4] ESP bases its probability distributions on historical out-turns as well as forecasts of the relative supply and demand balance. ESP assumes (1) that power will flow from BETTA to I-SEM whenever there is scarcity in I-SEM and no scarcity in GB and (2) that power will not flow from BETTA to I-SEM if there is scarcity in GB. Both these assumptions reflect relative scarcity in each market. However, in addition, ESP assumes (3) that power will *not* flow from I-SEM to BETTA if there is scarcity in GB,[5] an assumption which is unrelated to relative scarcity or to any specific policy on cross-border flows. If there is nothing to prevent power flowing from I-SEM to BETTA in such conditions, ESP's model will overstate the potential contribution of the interconnectors.

ESP has not provided the details of its calculations and has left several terms undefined. The Consultation does not provide any intermediate results, such as its coincident probabilities. These omissions make it difficult for market participants to review ESP's method or to assess the likely impact of ESP's assumptions.

In summary, ESP's overall approach of modelling the supply and demand balance, rather than prices, overcomes certain difficulties with forecasting scarcity prices. Instead, ESP makes assumptions about how power will flow during periods of individual or coincidental scarcity in the I-SEM and BETTA. These assumptions (and others, so far as we can tell from the limited description) tend to overstate the likely contribution of interconnectors to meeting scarcity within the I-SEM. We discuss these assumptions further in sections 3-6 below.

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3 ESP (2016), *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016, paras 2.1.4-2.1.5.

4 ESP (2016), *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016, paras 2.2.4.

5 ESP (2016), *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016, paras 2.1.4-2.1.8.

3. ESP's Assumptions on Interconnector Flows May Overstate Availability

ESP assumes that net flows on the interconnector would be zero if there were a simultaneous scarcity event in BETTA and I-SEM. This assumption overstates the availability of interconnectors during scarcity events, since there is some positive probability of power flowing from the I-SEM to BETTA in such conditions. If this probability is not reflected in the capacity requirement used in the CRM auctions, it would have to be reflected in a further de-rating of the interconnectors.

Under current plans, the price cap will be higher in BETTA (initially £3,000/MWh, rising to £6,000/MWh) than in the SEM (€3,000/MWh under I-SEM[6]). Therefore higher prices in GB may draw exports from I-SEM when there is a shortage in both systems (unless the RAs envisage an official restriction on exports being imposed at such times). In principle, the de-rating factor calculated by ESP's proposed method will systematically overstate the likely contribution of the interconnectors at times of system scarcity in I-SEM because it does not take account of the possibility of exports during scarcity events in I-SEM. The SEM-Committee would need to de-rate the interconnectors further, compared to ESP's results, to take account of the possibility of exports during scarcity events – or else the RAs should explain what restrictions will be applied to exports during periods of scarcity, in order to validate ESP's assumption (or to explain how this possibility affects the capacity requirement). ESP does not provide enough information in the Consultation Paper to allow us to assess the materiality of this assumption, which depends on the probability of coincident system scarcity.

The absence of net flows in either direction during stress events is not the only one of ESP's assumptions which may systematically overstate availability to meet scarcity in I-SEM. ESP's methodology estimates the availability of power across the interconnectors based on scarcity in BETTA and I-SEM as a whole and takes no account of transmission constraints in either BETTA or I-SEM. For instance, National Grid manages a constraint between England and Scotland, which requires it to ensure that 3GW of dispatchable capacity is available in Scotland to support peak demand.[7] The combination of transmission constraints and renewables policy in Great Britain is resulting in increasing wind penetration and a shortage of peaking capacity in Scotland over the longer term .[8] Accordingly, on cold days with low wind speeds, Scotland may become a deficit area. Transmission constraints between England and Scotland may mean power does not flow across the Moyle interconnector to meet demand in I-SEM even though BETTA as a whole is not

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6 ESP (2016) *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016, para 2.14.

7 National Grid (2015), *Electricity Ten Year Statement*, page 107.

8 NERA's recent modelling work for the Competition and Markets Authority to support the energy market inquiry in GB shows than under all of the forecast scenarios, additional peaking capacity is required in Scotland to meet system demand and generate when wind plant are not, given constraints in the transmission system in GB. NERA (2016), *Modelling the Impact of Zonal Transmission Loss Multipliers*, Prepared for the CMA, 9 March 2016, page 37.

suffering scarcity. ESP's model does not take account of this possible scenario, even though the existence of the constraint has been documented by National Grid, and so overstates the potential contribution of the Moyle interconnector.

4. ESP (Incorrectly) Assumes that Wind and Temperature Are Uncorrelated

ESP is proposing to link the "GB Daily Peak Demand Scenario" to the "SEM Daily Peak Demand Scenario", so that the level of demand in Great Britain is conditional on the level of demand in the I-SEM.[9] In practice both demands are independently driven by temperature, but ESP's rationale for adopting this approach may be that the level of demand in I-SEM provides information on additional factors affecting demand for electricity (like wind chill, cloud cover, etc.) over and above the information available from the Temperature scenario. ESP describes its analysis (paras 3.3.13-3.3.19), but does not explain its choice of approach, or why I-SEM demand should determine GB demand *and not vice versa*. Such additional explanation would be useful to market participants.

More seriously for the current document, ESP's description implies that temperature and wind are independent variables (separate "Monte Carlo picks").[10] In practice very low temperatures tend to coincide with low wind speeds. This coincidence increases the probability of scarcity. Indeed, ESP note that "there is a clear effect in the days of highest peak demand whereby wind is lower than would be expected on a typical winter day" but does not say how it accounts for this adverse correlation in its methodology.[11] ESP mentions a variation ("sensitivity") to the base case, called "Reduced wind at highest demand", in section 9 of the Consultation document, but does not describe in detail how it derived this sensitivity or whether it applied the sensitivity to I-SEM or BETTA or both.

Figure 2.1 below shows average wind speeds (blue dashes) for different standardised[12] temperature bands (red columns), using data gathered from Dublin airport for the last thirty years. Wind speeds fall substantially in both very hot and very cold weather. Indeed, the very lowest wind speeds occur in very cold weather, when demand is high. This Figure explains why ESP found no correlation between demand and wind speeds: the relationship between wind and drivers of demand (such as temperature) is non-linear (and hump-shaped). Moreover, ESP's approach focuses on the wrong periods: It is not important whether wind and demand are correlated *on average* for the purposes of its analysis, but only what the relationship between them is in *high-demand periods*.

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9 ESP (2016), *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016, paras 2.2.15.

10 ESP (2016), *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016, paras 2.2.25-27.

11 ESP (2016), *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016, paras 4.1.4.

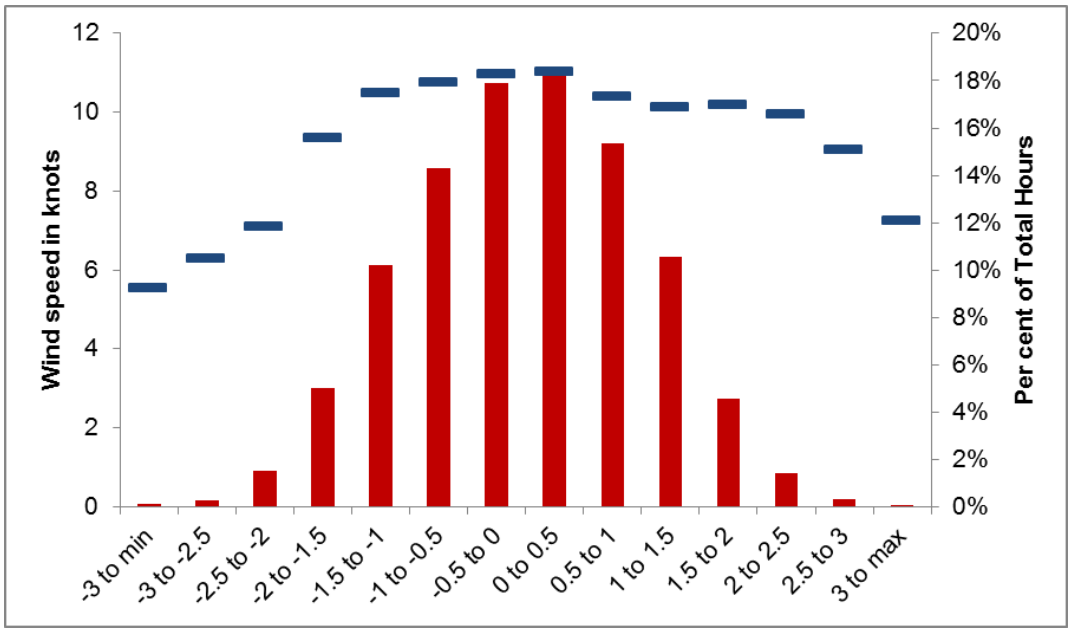
12 We standardised temperatures using the average (9.75 C) and standard deviation (4.9 C) over the thirty-year period, so a value of "3" or more represents a very hot day, and "-3" or less a very cold one.

The same problem affects GB demand and wind forecasts. See the data below in Figure 2.2 for January-February 2010 in Great Britain, which saw unusually severe and widespread cold weather coincide with very low wind generation.

The Consultation document states that the model uses a "Monte Carlo pick" to define GB wind output "accounting for the correlation at the daily level between I-SEM and GB wind production".[13] However, ESP does not provide sufficient detail for market participants to assess its approach.

ESP presents a sensitivity analysis to the contribution of wind at times of system peak in the Consultation, which purports to account for the reduction in wind at times of peak demand. This sensitivity shows only a slight reduction (of 0.6 percentage points) in the effective capacity of the interconnector. However, the basis of this sensitivity, as described briefly in the Consultation document in para 9.1.13, appears to be arbitrary and not to be justified with reference to ESP's data on wind speeds and temperatures. Accordingly, market participants cannot have any confidence that the sensitivity properly adjusts for the reduction in wind speeds at peak times.

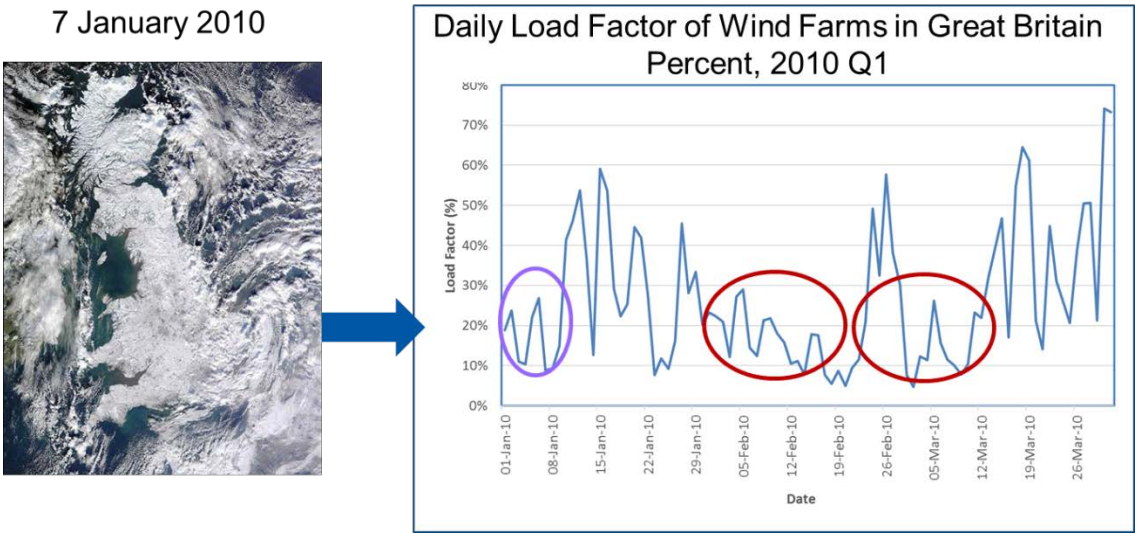
Figure 4.1
Wind Speeds Tend to be Low in Hours with Very High or Very Low Temperatures



Source: NERA Analysis and MET Eireann, http://www.met.ie/climate-request/

[13] ESP (2016), *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016, para 2.2.17 and again discussed in section 4.

Figure 4.2
Severe, Cold GB Weather Coincides with Very Low Wind Generation



Sources: UK Met Office[14] *and proprietary database*

5. ESP's Assumptions about the Supply and Demand Conditions in Great Britain May Overstate the Availability of Capacity in GB

ESP relies on National Grid's "Slow Progress" scenario from its "Future Energy Scenarios" to estimate the supply and demand balance in Great Britain. Relying on only one of National Grid's scenarios is an unreliable basis for estimating the availability of the Moyle interconnector and EWIC during times of system scarcity, for several reasons.

Firstly, the aim of National Grid's Future Energy Scenarios is to illustrate the range "potential changes" in the demand and supply energy balance in Great Britain over the long term to 2040. None of the scenarios purports to be a short or medium term forecast of the supply and demand balance.

Secondly, the choice of the "Slow Progress" scenario is selective: "Slow Progress" is assumes low rates *both* for future economic and demand growth and for decarbonisation.[15] Accordingly, it may understate both wind penetration and the tightness of the supply/demand balance in Great Britain, particularly in the short term, relative to National Grid's other scenarios. Relaxing either of these assumptions would tend to make Great Britain a less reliable source of imports for I-SEM.

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14 *http://www.metoffice.gov.uk/about-us/who/how/case-studies/winter09-10*

15 National Grid (2016), *Future Energy Scenarios*, July 2016, pages 16 and 17.

Thirdly, as we have argued elsewhere, National Grid's Future Energy Scenarios systematically overstate the likely level of security of supply on a four-year timetable.[16] National Grid's forecasts typically:

- Assume that plant which won capacity market contracts will be available in practice, despite the evidence that some new plant will not be built, such as the new 1.9GW CCGT at Trafford which is experiencing financial difficulties.[17]
- Make no provision for the impact of the current review of the embedded benefits regime in GB, which threatens to reduce revenues for small-scale diesel plant from currently forecast levels of £80/kW to an unknown, but potentially much lower, level.[18]
- Assume an optimistic contribution of wind to meet load at peak times.[19]

The combination of these concerns all suggest that ESP's methodology overstates the potential contribution to I-SEM security of supply made by flows over interconnectors.

6. In Great Britain, Prolonged Outages Were Included in Historical De-rating Factors for the Capacity Market

ESP's proposed methodology includes adjusting for "a very long term outage on Moyle".[20] In principle, any de-rating factor should take account of all the outages that may occur in the year of delivery. Unless there is any reason to believe that the outage at Moyle will never occur again, there are no grounds for excluding those outages when calculating de-rating factors prospectively.

As a matter of fact, interconnectors often experience prolonged outages. We understand that there is currently another extended outage on the EWIC, which suggests that extended outages are a recurrent feature of the Irish interconnectors, at least at present. We note that the Basslink (Victoria-Tasmania) interconnector recently experienced a prolonged outage at a time of extreme scarcity in Tasmania (due to low hydro output)[21] and that maintenance work reduced the annual availability of the France-England interconnector below 60 percent in 2011 and again in 2012/13.[22]

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16 See for instance our critique in NERA (2015), *Paying Peanuts: Will the British Capacity Market Deliver Security of Supply*, 12 October 2015, pages 28-30.

17 *Blow for UK as Manchester gas power plant runs into trouble*, Power Engineering International, October 2015; and *Trafford's £800m gas-fired power plant given funding extension*, BBC News, 6 July 2016.

18 Ofgem (2016), *Open letter: Charging arrangements for embedded generation*, 29 July 2016.

19 See for instance our critique in NERA (2015), *Paying Peanuts: Will the British Capacity Market Deliver Security of Supply*, 12 October 2015, page 29.

20 ESP (2016), *CRM Consultation – Interconnector De-rating Methodology*, 19 August 2016, paras 2.2.28.

21 *No end in sight for Tasmania's costly energy crisis*, ABC News, 21 April 2016. *Basslink cable up and running, restoring power flow between Tasmania and Victoria*, ABC News, 13 June 2016.

22 *UK-France power cable performance worst in at least a decade*, Reuters, 7 August 2013.

De-rating factors used in the British market explicitly adjust for prolonged interconnector outages. DECC relies on a "hybrid" methodology: the de-rating factor for an interconnector depends either on historical data or modelled forecasts, whichever methodology results in a larger de-rating factor (i.e. in a lower interconnector capacity). The methodology for the historical de-rating factor finds the percentage of hours during periods of high demand[23] where the day-ahead wholesale price in Great Britain was higher than that in the interconnected country and power flowed into BETTA across the interconnector.[24] The methodology for calculating historical de-rating factors therefore incorporates prolonged maintenance periods by default. The methodology for forecasting de-rating factors uses stochastic modelling and will not therefore include idiosyncratic maintenance periods, unless DECC anticipates that they will occur again in future.[25] However, DECC explicitly states that its final de-rating factors "need to take the latest market intelligence into account" and that it will only guarantee a minimum de-rating factor based on historical performance wherever there are "no publically reported concerns about the security of supply outlook in the connected market".[26] DECC therefore allows for the possibility of including prolonged outages.

Given the relatively small size of the Irish market and the combined nameplate capacity of 950MW for Moyle and EWIC, excluding prolonged outages when assessing interconnector availability would impose an even bigger risk for security of supply than in Great Britain. It would therefore be wise for the SEM Committee to be at least as prudent in setting the de-rating factors for the interconnectors as DECC has in Great Britain, by allowing for long term outages.

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[23] The hours with the top 50% of GB demand during the Core Winter Period on weekdays from 7am to 7pm.

[24] If flow data for a full 7 years is not available, the percentage of hours where the Day-Ahead wholesale price is greater in GB is used, and then adjusted downward for other factors like technical availability, ramp rates, etc.

[25] "Schedule 3A: Methodology for Determining the De-Rating Factor for an Interconnector CMU" in "Consolidated Version of the Capacity Market Rules", UK Government, 14 July 2016, pages 195 to 196.

[26] Electricity Market Reform (2015), *Announcement of de-rating methodology for interconnectors in the Capacity Market*, page 7.

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