elementpower

Stuart Borland
Ofgem
9 Millbank
London, SW1P 3GE

05 May 2015

Dear Stuart,

Response to consultation on Ofgem's Cap and Floor regime: Initial Project Assessment of the FAB Link, IFA2, Viking Link and Greenlink interconnectors

Element Power (EP) encloses its response to the above consultation. Please regard this to be a public response. Please regard this to be a public response, except for those annexes marked as confidential.

In summary, EP believes that Ofgem should undertake a thorough review of its minded-to position on Greenlink in the light of the information and analysis provided in this consultation response. This review should include a re-run of the analysis undertaken by Pöyry and a revision of the original NGET assessment, all of which we firmly believe will lead Ofgem to a decision to accept Greenlink into the Cap and Floor regime. This is a project that we believe will lead to material benefits for GB consumers, enhances the interconnection of European networks, and will be supported in Ireland given the benefits that also accrue there. You will see in this consultation response that the grounds for this assertion are absolutely solid and compelling.

We understand that it is Ofgem's intention that the consultation on this matter is conducted in a genuine and transparent manner, and is not simply a process to reaffirm its original minded-to position. We expect that any valid evidence and/or new information coming to light that calls into question the grounds for the original position and the position itself will be given appropriate consideration and action. We also expect that Ofgem will be, and will wish to be seen to be, consistent in their approach in assessing the potential interconnectors including Greenlink when making their final decisions.

We believe that Ofgem has come to its minded-to position on the basis of incorrect modelling methodologies that do not reflect the conditions that Greenlink will be operating in from 2020. Further, we believe that information that has underpinned Ofgem's analysis has either been misinterpreted, or omitted altogether. Specifically:

- National Grid Electricity Transmission's (NGET) constraint cost analysis as published is inaccurate. NGET has reassessed the cost based upon up to date background generation, Greenlink's queue position and Greenlink's provision of an intertrip. This has resulted in **reducing the constraint costs in Greenlink's lifetime to zero** in NPV terms leaving a small cost of less than £1m NPV Greenlink's across all scenarios **(previously a cost of £147m to £438m, depending on scenario)**.
- Greenlink's ability to provide Fast Frequency Response has been omitted from NGET's analysis altogether. Based on a like-for-like comparison with other interconnectors, we estimate the impacts of this are significant, providing benefits of between **£400m to £535m.**
- Ofgem's market modelling, conducted by Pöyry, does not reflect the intended design of the Irish market in 2020, as evidenced by public documents. The modelling allows for a system constraint to affect interconnector flows, which the Irish regulator has also said is inconsistent with the intended

design. When the market modelling constraint is removed, we show that the market modelling should add approximately **£120m to GB consumers and £173m to GB overall in Ofgem's Base Scenario, and £399m to both GB consumers and GB overall in its High scenario.**

In addition, we also set out details of other GB benefits provided by Greenlink that are not captured by the analysis framework, or are as a result of new information that needs to be taken into account. These have a further material positive impact on Greenlink's CBA results, of up to **£106m** on GB consumers, and up to **£228m** on GB overall. The table below shows the total impact of all of the factors highlighted in this consultation response, all of which we consider valid and overall clearly provide justification for Ofgem to revise their current position. We welcome any third party scrutiny of our assertions and analysis, and in particular we encourage Ofgem to instruct the re-run of the analysis undertaken by Pöyry in light of the new information on the direction of system design in Ireland.

Table 1: Impact of individual factors discussed in this response

	GB Consumer Impacts			GB Producer & I/C Welfare			GB Total Welfare Impacts		
£m NPV, (2013 prices)	Base	Low	High	Base	Low	High	Base	Low	High
Constraints & Intertrip	292	438	147	-1	-1	-1	291	437	146
Ancillary Services	467	400	535	0	0	0	467	400	535
I-SEM SNSP correction	120	0	399	53	0	0	173	0	399
Irish Wind Capacity in 2020	59	0	0	35	0	0	94	0	0
Moyle Restrictions	13	13	13	8	3	11	21	16	24
Lower Greenlink Losses	0	0	0	30	10	40	30	10	40
Probabilistic Modelling	34	6	58	49	16	66	83	22	124
Total impacts	**985**	**857**	**1152**	**174**	**28**	**116**	**1159**	**885**	**1268**

Table 2: Revised Greenlink GB consumer and total welfare after accounting for factors above

£m NPV, (2013 prices)	Base	Low	High
Total quantified GB consumer impact	726	133	1226
Total quantified GB impact	822	304	1269
Total quantified GB consumer impact (with CM)	745	167	1255
Total quantified GB impact (with CM)	841	338	1298

Detailed information and analysis on all of these points is presented in section 1 of this response. Having addressed these inaccuracies and omissions, we consider that Greenlink should receive a positive IPA decision. Therefore, EP formally requests Ofgem to update its analysis ahead of making its IPA decision on Greenlink.

Ofgem has directed EP to this consultation response to formally provide its feedback on the material presented in its consultation paper. Therefore, in this response, we provide Ofgem with the following information:

- Section 1 provides details of why we believe that NGET analysis of Greenlink's impacts on constraint costs, and Pöyry's analysis of Greenlink are based on incorrect assumptions, with the relevant documentation and communication from the Irish authorities and Transmission System Operators (TSOs). It also provides information on additional areas where we believe Greenlink adds value for GB; and
- Section 2 provides Answers to each of the questions set out in Ofgem's consultation paper.

The Annexes to this response provide background to how EP has engaged with the consultation process to date, and excerpts from relevant documents supporting the EP's position on Ofgem's modelling.

I trust that this submission will provide all of the information that Ofgem will need to assess the case for re-considering its minded-to position on Greenlink. Please do not hesitate to contact either me or Guy Nicholson if there is anything further that EP should provide, or anything further that you would like to discuss.

Yours sincerely,

Mike O'Neill

CEO, Element Power

Element Power Limited, 2nd Floor Meridien House, 42 Upper Berkeley Street, London, W1H 5QJ, UK

1 Details of the grounds for disagreement with NGET analysis on system impacts, and Pöyry's analysis of Greenlink

1.1 Introduction

This section describes why EP believes that some of the key assumptions underpinning NGET's and Pöyry's analysis of Greenlink's are incorrect.

There is a significant amount of evidence to demonstrate that the approaches taken by NGET and Pöyry in their respective analyses for Ofgem do not reflect the market or system conditions that Greenlink will be operating in from 2020 and beyond. It is vital that these approaches are addressed and amended prior to Ofgem making its decision, because as things stand, they paint a highly inaccurate and very negative picture of Greenlink's impacts on GB, as shown in Ofgem's summary results in Table 3 below. This has clearly led to Ofgem's original minded-to decision.

Table 3: Ofgem's summary analysis for Greenlink[1]

		Ofgem Greenlink results - no CM		
	£m NPV, (2013 prices)	Base	Low	High
System analysis	System Operation costs	-292	-438	-147
	System Operation benefits	0	0	0
Market analysis	GB consumer impacts	33	-285	221
	GB producer and IC impacts	-78	142	-73
Combination	**GB consumer impact**	**-259**	**-723**	**74**
	GB overall welfare impact	**-337**	**-581**	**1**

In the sections below, we present evidence to demonstrate that the NGET analysis for Greenlink's impacts on System Operation costs should be zero, **which has been accepted by NGET**. We also demonstrate that Greenlink has a capability to provide system operation benefits to an even greater extent per MW than the other proposed interconnectors in terms of Fast Frequency Response.

In addition, we also present evidence to show that Pöyry's market modelling on GB consumers should present significantly higher positive GB consumer impacts, and GB overall welfare impacts. We quantify all of these changes as far as possible[2], and show that they change Ofgem's summary results significantly as a result.

The following sections cover changes, revisions and updates to the following factors for Greenlink.

- Constraint costs
- Ancillary services – provision of fast frequency response
- Modelling of I-SEM and treatment of SNSP constraints in the market model
- All Ireland wind capacity expected in 2020
- Restrictions on Moyle flows in Ireland to GB direction from 2017

[1] From Table 5 Page 18 – re-arranged and not showing the Capacity Mechanism results (which were more positive for GB consumers and overall).

[2] Where our previous modelling has quantified impacts, these results have been included. For other factors we have focused on the value for GB consumers and GB interconnectors, using logic based upon the Pöyry modelling information supplied, and the Baringa modelling commissioned by EP.

- Greenlink losses which are lower than East-West
- Probabilistic market modelling.

1.2 Constraint Costs

1.2.1 Background

NGET, the GB System Operator (SO), has provided reports to Ofgem on the system impacts of each of the proposed interconnectors that have been used in the latter's minded-to position. These reports have quantified:

- The impact that each project may have on the value of ancillary services, and
- The operational cost (constraint cost) implication of each interconnector connecting to the GB transmission system.

In constraint costs NGET has only considered the year 2020, and only used its Gone Green Scenario to conduct its analysis. It has used a range of price forecasts for European markets to determine interconnector flows on which it based its analysis, creating Low, Mid and Upper Scenarios.

NGET had set out that Greenlink will create annual operational costs by increasing boundary constraints by £27m, £18m and £9m in 2020 in its Low, Mid, and Upper forecasts respectively. We disagree with these results because the analysis does not account for boundary information that was available at the time the report was produced, which removes constraints due to Greenlink. This has been accepted by NGET in our subsequent communications.

There are three areas where important information has either been omitted or misinterpreted in NGET's analysis of the SW2 boundary:

- On background and contracted generation,
- On network reinforcements, and
- On Greenlink's connection design – specifically the inclusion of an intertrip.

We discuss these in turn[3].

1.2.2 Contracted and background generation behind SW2

The constraint modelling includes connections that are either no longer contracted, have since delayed their plans, or are due to connect in a different order than assumed. Further, NGET modelled a number of contracted parties to connect ahead of Greenlink, which were not ahead of EP at the point that it signed its connection agreement. These connections include:

- Energy Bridge, a renewable export project which held 2500MW behind the SW2 boundary which handed back its Transmission Entry Capacity (TEC) on 18 July 2014[4], which was therefore incorrectly modelled as part of National Grid's constraint analysis;

[3] This summary is based on a LR-Senergy Report "PE14EPI005HGreenlink Boundary Assessment V1" which has been shared with NGET and is submitted to Ofgem as Confidential supporting information.

[4] See July 2014 TEC register from National Grid

- Greenwire, EP's renewable export project (1500MW at Pembroke, in addition to Greenlink's 500MW capacity), which is programmed to connect after Greenlink; and
- More recently, the 490MW South Hook CHP plant, which has announced that development construction plans have been put on hold[5].

Accounting for these corrections, the background and contracted transmission capacity that should be assessed for the purposes of calculating constraint costs is the 3471MW that existed in the TEC register at the point that EP signed its connection agreements. As the SW2 boundary capacity is rated at least 3600MW, and there is 220MW of minimum load, a 500MW interconnector could theoretically overload the boundary by 150MW in a scenario with all generation at full load (including coal, wind, gas and hydro) at minimum, and summer circuit ratings, which is a highly improbable scenario.

1.2.3 Network reinforcements on SW2

National Grid's modelling paid no recognition to the planned Swansea turn-in, which is a reinforcement that will increase voltage stability behind the boundary. It is a highly relevant reinforcement to the constraint modelling given that SW2 is thermally capable of 5500MVA, but voltage constrained to 3600MW.

1.2.4 Greenlink's connection

Lastly, NGET's modelling of the SW2 boundary has not included the Infrequent Infeed Loss Limit as it has with other boundaries[6]. If this were included, the capacity of the boundary could be lifted by 1800MW.

NGET's constraint analysis has not taken into account that Greenlink's connection would likely feature an intertrip which would only be fired in the event of an actual overload caused by a double circuit fault. Although arming the intertrip has zero cost, if the intertrip is fired, Greenlink will be out of balance in the GB and Irish markets and unable to trade until its positions are resubmitted and the interconnector can recommence real power flows[7]. A highly conservative calculation on the fault and outage probability per annum is provided in Annex B. The NPV impact of this operational intertrip cost is estimated at £671,000 on Greenlink's revenues, over its 25 year life[8].

1.2.5 Summary

EP considers that the information above should have been accounted in NGET's original analysis. It is not credible, nor considered fair treatment, to place Greenlink behind projects that were later in the connection queue, or that had fallen away at the point that NGET performed its analysis. Further, as the modelling does not reflect network reinforcements that are being carried out to relieve constraints, the initially erroneous constraint cost result has been exaggerated. Therefore, Ofgem must reconsider the use of the NGET analysis

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[5] See: http://www.southhookchp.com/files/6414/2289/6376/FID_Press_Release_-_FINAL.pdf

[6] ETYS 2014 Section 3.10 Page 124 the NW1 boundary allows 1800MW to be lost on a double circuit fault.

[7] An intertrip would be expected to operate on the real power flow control of the HVDC VSC leaving the converters (at both ends) connected to the grid, where their voltage control and reactive power capabilities would help to stabilise the networks post fault and post intertrip operation.

[8] Using the lost energy per annum, and imbalance costs comprising the spread between a theoretical System Buy Price of £59/MWh (the average GB wholesale market price from the CBA modelling) multiplied by a factor of 1.5 to reflect higher prices as a result of EBSCR (historical relationship is approximately 1.2x MIP), and a sell price of -£25/MWh, reflecting the short run marginal price of wind on the margin in Ireland when Greenlink is importing into GB, as a worst case.

as it currently stands, and either remove or re-perform the analysis on the basis of the SW2 boundary information presented above.

In addition, EP has presented this analysis to the NGET economic modelling team over a number of bilateral meetings and communications held during the consultation periods. EP has received supportive feedback from the **NGET team who have agreed that the constraint costs should be zero**, which emphasises the need for Ofgem's reconsideration.

1.2.6 Conclusions

The combination of reducing the background generation at SW2, accounting for planned reinforcements, and reflecting Greenlink's connection design will produce **zero constraint costs per annum in 2020 across all of National Grid's scenarios for the system operator. The NPV impact on Greenlink of the intertrip operation is less than £1m**.

Accounting for the changes discussed with NGET, EP considers Ofgem's CBA results will change as indicated by the orange shaded line in Table 4 below.

Table 4: Greenlink constraint cost corrections

	GB Consumer Impacts			GB Producer & I/C Welfare			GB Total Welfare Impacts		
£m NPV, (2013 prices)	Base	Low	High	Base	Low	High	Base	Low	High
Constraint costs removed	292	438	147				292	438	147
Intertrip operation costs added				-1	-1	-1	-1	-1	-1
Constraints & Intertrip	292	438	147	-1	-1	-1	291	437	146

1.3 Ancillary Services Benefits

NGET's report to Ofgem[9] considered the following ancillary services:

- Frequency response
- Black start
- Reactive response
- Boundary capability delivered (displaced investment)
- Constraint management

Constraint management has been addressed in section 5 of this report; Black start, Reactive Response and boundary capability are localised and of relatively modest value as shown in NGET's analysis. Comparison of the data in Ofgem's consultations shows that all other interconnectors in the assessment have very similar ancillary service values, which is evidence to show that the principal value in this calculation lies in Frequency Response as the only common service. Although "high" and "primary" responses are discussed, quantified fast frequency values are reported, as per page 17:

"*In this [NGET's] report the value of providing fast frequency response by the Interconnector under study is presented*".

[9] NGET's SO submission on quantified interconnector impacts, 16 December 2014.

NGET's assessment of Greenlink's contribution of Fast Frequency Response benefits to GB was £0 in 2020, on the basis that it had not been studied due to the Irish network being a significantly smaller system. It said that joint investigations would be required with EirGrid to determine the potential for the provision of fast response. However NGET also states (on page 2):

"*It should also be recognised that further discussions are required with adjacent TSOs to ensure that neighbouring networks can support the provisions of services described".*

So it appears that all interconnectors require discussions with appropriate TSOs before the value can be confirmed. Pending those ongoing investigations and to ensure equal treatment we believe that there is a clear argument set out below to credit Greenlink with fast frequency response value as Ofgem has done with the other interconnectors.

In assessing the value there are two matters to consider:

a) How much response can the Irish system provide?
b) What proportion of time is Greenlink able to provide that response?

1.3.1 How much response can the Irish system provide?

If Greenlink provided 10% of its capacity as fast frequency response, (i.e. the same fraction as other interconnectors) this would require 50MW from the Irish system. We do not consider that there should be any reason for concern for this volume as we set out below.

Consider a situation when Greenlink (or one of the existing interconnectors, such as East West) is exporting to Ireland from GB at 500MW and trips. In this situation, Ireland needs to provide sufficient Replacement Reserve to contain this loss[10], assuming it is a permanent loss, and sufficient Inertia to limit the rate of change of frequency[11].

In comparison, with Greenlink exporting 500MW from GB to Ireland the interconnector can provide 50MW of fast frequency response to GB by ramping down over 2seconds to 450MW; holding for 10 seconds; and ramping up again over 2 seconds to 500MW. The function is shown diagrammatically in Annex E. This response results in an energy loss to the Irish system of only 600MWs[12] and in our view is readily manageable.

If we compare Greenlink and the other proposed interconnectors with the ENTSO-E incident thresholds[13] we see that

- Greenlink at 500MW is 100% of Irish peak threshold,
- NSN at 1400MW is 93% of Northern Europe peak threshold, and
- IFA2 & Viking & FAB Link totalling 3400MW are 227% of the Continental Europe threshold.

[10] Restoration Reserves comprise of Frequency Containment Reserves (to halt the fall in frequency cause by the infeed loss) and Frequency Restoration Reserves to accelerate the power system frequency back to its previous 50Hz level.

[11] For a 500MW instantaneous loss an Irish system inertia of 25000MWs is required to hold ROCOF to 0.5Hz/s

[12] I.e. 600MWs = 600Megajoules= 0.17MWh

[13] ENTSO-E incidents Classification Scale Methodology Table 5.

On this basis there should be more concern about the impact of the last three interconnectors in combination than there should be regarding Greenlink.

In addition, 50MW of response in Ireland at 10% of the largest infeed loss is equivalent to 180MW[14] of response in GB shared with continental Europe. One of the purposes of interconnection in Europe is to share such reserves and responses and in our view National Grid could readily share 180MW of its existing reserves with its neighbours.

We note that specific provision has been made for the sharing of Frequency Containment Reserves between Ireland and GB in Article 60 of the Network Code on Load Frequency control, where we expect that Greenlink's additional cross border capacity would increase Operational Security and thus improve the limits for sharing of response between the two markets.

Therefore we see no reason why Greenlink should not provide 50MW of capacity from Ireland, the same 10% of capacity as it credited to the other interconnectors.

1.3.2 Greenlink availability for response

Both Pöyry's and Baringa's analyses show for a material proportion of time, Greenlink's flows will either be exporting to Ireland, or alternatively at float, therefore Greenlink's availability to provide fast frequency upwards response (i.e. flow into GB or reduced flow from GB) will be far greater relative to the other interconnectors assessed which are primarily importing to GB, and which will be physically constrained to provide any more power to GB at these times. In their report NGET have assumed that other interconnectors are "… limited to either **5%** or **10%** of capacity of the link being made available to provide fast response respectively (capacity being restricted to this value to minimise both the impact on potential trading opportunities and impact on external systems providing this service)."

1.3.3 Greenlink fast frequency response value

As a new project Greenlink can be designed and specified with the requisite control systems to provide this fast frequency response in the same manner as the other interconnectors in the IPA process.

We have analysed Ofgem's consultation[15] and calculated average annual values per MW for the other interconnectors' ancillary services. Given Greenlink's operation with significantly less time importing to GB than the other interconnectors we have assumed that the fast frequency response capability is available for twice the time, hence there is twice the value per MW of the other interconnectors. We have thus calculated the value of Greenlink's ancillary service provision to provide benefits of **£24m, £28m and £32m per annum in the Low, Mid and Upper scenarios,** which has an NPV impact of **£400m, £467m and £535m** respectively.

These changes to the GB Consumer and GB Total Welfare cases are shown in Table 5.

Table 5: Greenlink revised ancillary service benefits

	GB Consumer Impacts			GB Producer & I/C Welfare			GB Total Welfare Impacts		
£m NPV, (2013 prices)	Base	Low	High	Base	Low	High	Base	Low	High

[14] 10% of the GB largest infrequent infeed loss limit of 1800MW

[15] Cap and Floor consultations: Table 4.2 of NSN Consultation and Table 15 of IPA Consultation for the four interconnectors.

Ancillary Services	467	400	535	0	0	0	467	400	535

1.4 Irish market modelling methodology

1.4.1 Background

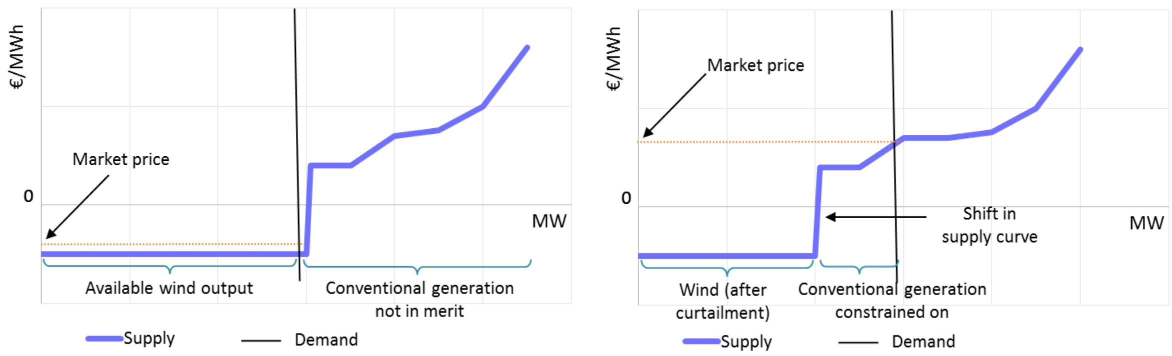
Low, and occasionally negative, prices in Ireland are one of the key drivers for Greenlink's revenues, as they provide the conditions for Greenlink to export to GB and collect significant market spreads in the process. They are also one of the main sources of GB consumer benefit, because exports from Ireland offset more expensive generation in GB, especially during the first half of Greenlink's cap and floor regime when low and negative prices set by Irish wind generation are less frequently mirrored in GB due to the slower relative deployment of wind in GB assumed in all the Pöyry models. Low Irish prices during these periods benefit GB consumers and ensure interconnector revenues exceed the floor.

The levels of wind assumed in both the Baringa and Pöyry studies mean that wholesale market prices in Ireland are forced down to low or negative levels, as wind is able to fully supply Irish demand plus interconnector exports in the market clearing process. Low prices are caused by wind having zero marginal costs, and being willing to pay to be dispatched in order to collect support scheme revenues.

Pöyry confirmed to EP and Ofgem that its results did not feature wind on the margin at any times. It explained that it has modelled a constraint in the Irish day-ahead market that will be used to schedule the interconnectors. The constraint was the System Non Synchronous Penetration (SNSP) limit, a system constraint, which is used in the current design of the SEM to limit the amount of non-synchronous generation operating on the system at any one time. The effect of the constraint is principally to maintain a level of inertia for the purposes of stabilising frequency in the event of loss of output from a single large generator.

As wind generation is non-synchronous, the impact of applying the constraint on the market run is to curtail available wind from the market dispatch. This means that generation with higher short run costs of production will set Irish market prices, as shown in Figure 1 below.

Figure 1: Impact of Poyry modelling on Irish market prices



The effect of modelling the SNSP constraint in the Irish market is to reduce the value of Greenlink's revenues (i.e. the value of the difference between the GB and Irish wholesale market prices) at times when Irish wind is generating at full output. Further, it reduces Greenlink's ability to export from Ireland to GB and to thereby lower GB wholesale market prices, and is therefore detrimental to GB consumer welfare. This can be seen in Pöyry's detailed CBA methodology and results, published in December 2014.

1.4.2 Design of I-SEM and information supporting an unconstrained market design

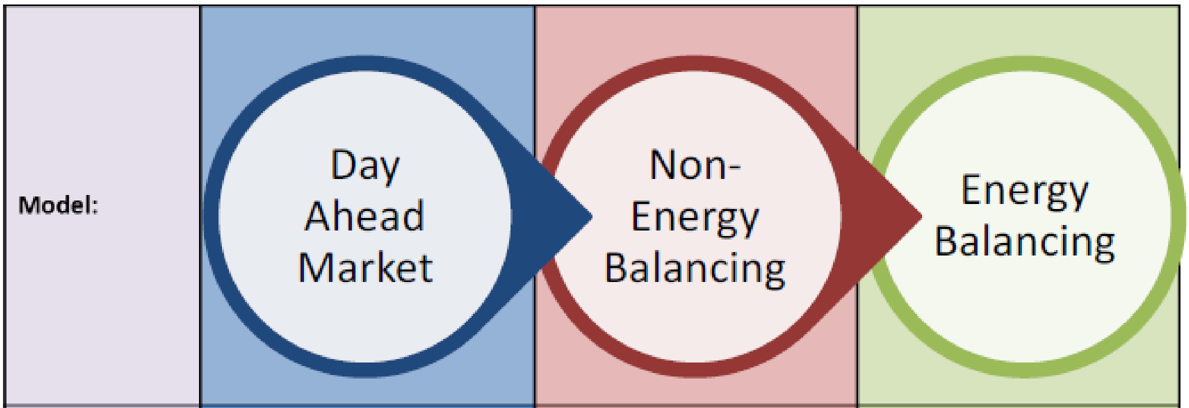
Ofgem published the content of Pöyry's explanation in its consultation document of 6th March. In the consultation, Ofgem set out that Pöyry had informed Ofgem that either including or excluding the SNSP limit in the market modelling are both plausible outcomes (p.60). The deciding factor on whether the SNSP limit is used in the market is the design of I-SEM and how this is handled.

Regarding the design of I-SEM, there is new information in public documents released by the Irish regulators and the TSOs that is robust and supportive of modelling the I-SEM day-ahead market as an unconstrained market design. One document explicitly sets out the unconstrained market as the intended design, while the other talks about an unconstrained market is considered as a "given". The two references are:

1. The SEM Committee's **I-SEM building blocks document**, where there are a number of references to curtailing wind generators (i.e. for SNSP) *back* from the commercial positions in the day-ahead, and intraday markets (i.e. cleared volumes of wind). Further, the same sections describe that these actions would be performed in the Balancing Mechanism or through cash-out. In other words, it is taken as a given that system constraints such as SNSP are not applied during market trading. Instead, they are managed with system actions by the TSOs outside of these markets, and within the Balancing Mechanism. **See Annex C for relevant extracts**

2. EirGrid's I-SEM modelling methodology document, where, to accurately reflect the design of the I-SEM, EirGrid explicitly sets out that system constraints (including SNSP) will be handled outside of the day ahead market and in the balancing mechanism **– See Annex D for relevant extracts, and Figure 2 below.**

Figure 2: Diagram from EirGrid I-SEM modelling methodology report, showing the Day-ahead market (the market modelled for determining interconnector flows) as unconstrained dispatch



Pricing:	Marginal	Marginal, Pay-as-Bid	Marginal
Constraints:		**Operational Constraints (e.g. Reserve, SNSP)**	Operational Constraints (e.g. Reserve, SNSP)
Outages:	Planned	Planned	Planned **Forced**
Wind:	Forecasted	Forecasted	**Actual**
Demand:	Forecasted	Forecasted	**Actual**
Horizon:	23:00-23:00	23:00-23:00	23:00-23:00
Look Ahead:	6 hours	6 hours	6 hours

Given this information is publically available, and now the detailed rules of the I-SEM are being designed around it, we believe that the advice that both options are viable is outdated, and therefore the approach taken to modelling the Irish market is no longer credible and cannot be used to support Ofgem's decision.

1.4.3 View from the Commission for Energy Regulation

EP has also asked the CER I-SEM team to provide its view on whether the SNSP constraint will be applied on the day-ahead market (DAM), where interconnector flows are scheduled. The team's response was:

"We expect that the DAM will be largely an unconstrained market. In particular, there are no intentions to try and input an SNSP limit into the DAM and it probably would not be workable...[16]"

The CER's description reflects an unconstrained day-ahead market where generators are able to reflect their available output, subject to prior commitments on that capacity, similar how the GB market is established.

The full email containing this text is provided in a confidential Annex to this response (Annex F).

1.4.4 Impact of re-running Pöyry's analysis

EP considers that the impact of reproducing Pöyry's analysis without the SNSP constraint on Greenlink's GB welfare results will be positive and significant to the outcome of Ofgem's IPA decision. Without access to Pöyry's model, it is difficult to precisely predict this uplift, however, EP believes it is able to gauge the quantum of impact using some approximations, which are provided in the following paragraphs.

[16] Sent to EP on 27 March 2015. Underlining emphasis by EP

Using the Irish wind load duration curve from an Irish Wind Energy Association (IWEA) study[17], it can be observed that for roughly 5% of the time, onshore wind is able to produce over 90% of its nameplate capacity, and for around 10% of the time, wind generators are able to produce over 70% of their nameplate capacity.

Taking the full wind duration curve and plotting it against average Irish demand and exports from interconnection, we can calculate the number of hours that demand and interconnection can be fully met by Irish wind (i.e. where wind would be on the margin). Under Pöyry's Base Scenario Irish wind assumptions, post 2025, we find that wind is fully supplying Irish demand plus imports for approximately 450 hours per year on average.

Assuming that 500MW of Irish exports are able to move the GB price downwards by £0.5/MWh, and that average GB demand across the period is 40GW, then Greenlink will deliver a £20,000 reduction in GB generation costs in each hour, which is a £9m saving per annum. The NPV impacts of this would be approximately **+£102m to GB consumer welfare in the Base Scenario.**

In addition, these periods would also increase interconnector revenues, which are a key component of the CBA. Considering Greenlink alone, in the Base Scenario, for at least 450 hours of the year, Greenlink would earn the difference between the short run marginal cost of wind in Ireland (assume this equates to -£25/MWh to reflect payment of subsidy value) and the wholesale market price in GB (assume this is £20/MWh to reflect GB wind also having an impact on the GB market price). Therefore, Greenlink would earn £22,500 per hour, and approximately £10m across the year from these periods alone. The NPV impacts of this would be +£106m, of which **+£53m would be distributed to GB interconnection[18]. Importantly, this would eliminate the floor payments currently featuring in Ofgem's summary analysis for the Base Scenario valued at £18m overall in NPV terms.**

For Pöyry's High Scenario, given the strong installed wind capacity assumptions, average demand will be met by wind output earlier and for more hours per year. Therefore, on the same assumptions used for the Base Scenario, EP expects a NPV impact of approximately **+£255m to GB consumer welfare,** and **+£144m to GB interconnector welfare, which would automatically add to the cap payments to GB consumers, given that Greenlink is already making payments to GB consumers under this scenario.**

However, we do not expect removing the constraint will impact upon Pöyry's Low Scenario given the extremely low levels of Irish wind assumed in this scenario. As we have said in discussions with Ofgem, **we do not consider this scenario to be credible as by 2015, Ireland has already achieved the levels of installed wind capacity assumed by Pöyry in the early 2020s.** We include more evidence on the Irish wind pipeline in section 1.5 of this response.

1.4.5 Conclusions on Pöyry's analysis of Greenlink

The impact of Pöyry's current modelling approach is extremely damaging to both Greenlink's GB welfare results and its commercial case (its revenues). A strong evidence base exists in the public domain which provides the basis of understanding for an unconstrained day-ahead market in Ireland, similar to that operating in GB today. Additionally, the Irish regulator has provided its view on intended design for I-SEM which again supports the same.

[17] J.P. Coelingh, 1999. Geographical Dispersion of Wind Power Output in Ireland. Available online.

[18] Assuming a 50/50 regulatory share between GB and Ireland.

Ofgem should consider this as robust evidence to justify a re-run of Pöyry's market model without the SNSP applied. EP has provided its view on the impact that this could have to Greenlink's welfare results, which are positive and significant enough to warrant a positive decision.

Accounting for our approximate calculations from section 1.4.4, we consider the impact on Ofgem's results will be as shown by the orange cells in Table 6:

Table 6: Irish Market SNSP corrections

	GB Consumer Impacts			GB Producer & I/C Welfare			GB Total Welfare Impacts		
£m NPV, (2013 prices)	Base	Low	High	Base	Low	High	Base	Low	High
I-SEM SNSP correction	120	0	399	53	0	0	173	0	399

1.5 Level of installed wind capacity in Ireland

1.5.1 Impact of different levels of wind in Ireland during the 2020s

The level of installed wind capacity assumed in Ireland has a significant impact on the benefits that Greenlink provides to GB consumers. The effect is particularly noticeable in the 2020s, with Ireland contracted to have more installed wind capacity as a proportion of its domestic supply curve relative to GB.

The benefits to GB consumers are delivered as follows: greater installed wind capacity creates a larger number of periods where wind is able to set prices in the Irish market (as the level of available wind generation alone is likely to exceed Irish demand plus exports from interconnection). At these times, the market price in Ireland is very low or at times negative[19], while in GB, the price is positive, as it is set by conventional generating capacity. The interconnectors between the two markets flow from Ireland to GB, displacing up to 1.5GW of plant from the top of the GB merit order. The reduction in the GB market price after the displacement effect from interconnection equates to benefits for the GB consumer.

This effect is more pronounced in the 2020s than the 2030s, because by the 2030s, it is expected that GB will also have relatively high levels of installed wind capacity. This wind will reduce the GB market price itself, and to a degree, owing to some partial correlation of wind between GB and Ireland, the effect of Irish exports on GB market prices will be less pronounced.

The extent of these wind-driven exports is sensitive to the level of wind assumed in Ireland given the average demand in Ireland of around 5GW and peak demand of around 7GW.

1.5.2 Installed wind capacity in Ireland in 2020s

The island of Ireland is targeting 40% electricity demand to be met by renewables (primarily wind) by 2020 to help to meet the Republic of Ireland's 16% renewable energy target and Northern Ireland's contribution to the UK's 15% renewable energy target under the RES Directive. EirGrid, the Irish TSO has published its expectation[20] that 4.7GW of wind will be operational in the Irish market (i.e. containing both countries) by 2020. Baringa assumed that higher levels of wind were operational in the market, at 5.7GW. We believe that

[19] As it is rational for wind generators to pay up to their expected support level to ensure that they dispatch. Both Baringa and Pöyry assumed that Irish wind bid negatively in the SEM to ensure that they dispatch.

[20] EirGrid's Generation Capacity Statement 2014

there is evidence to suggest that this higher level of wind capacity will be delivered, which is set out in the following paragraphs.

EP commissioned MullanGrid Consulting[21], to assess the pipeline of wind currently developing in both the Republic of Ireland and Northern Ireland in the context of installed capacities in the year 2020. The pertinent results of this study are set out in Figure 3 and Figure 4 below.

Figure 3: 2020 renewable electricity target, connected capacity and pipeline of wind development in Republic of Ireland

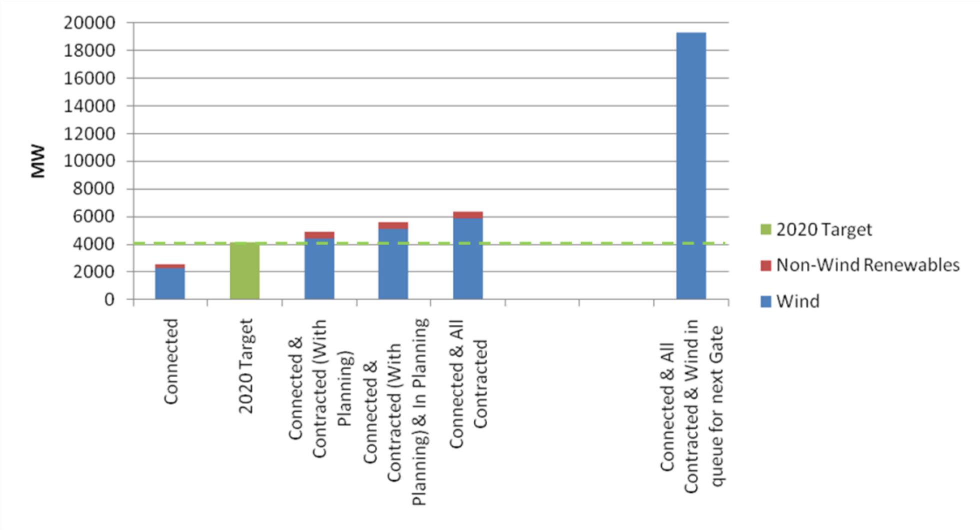
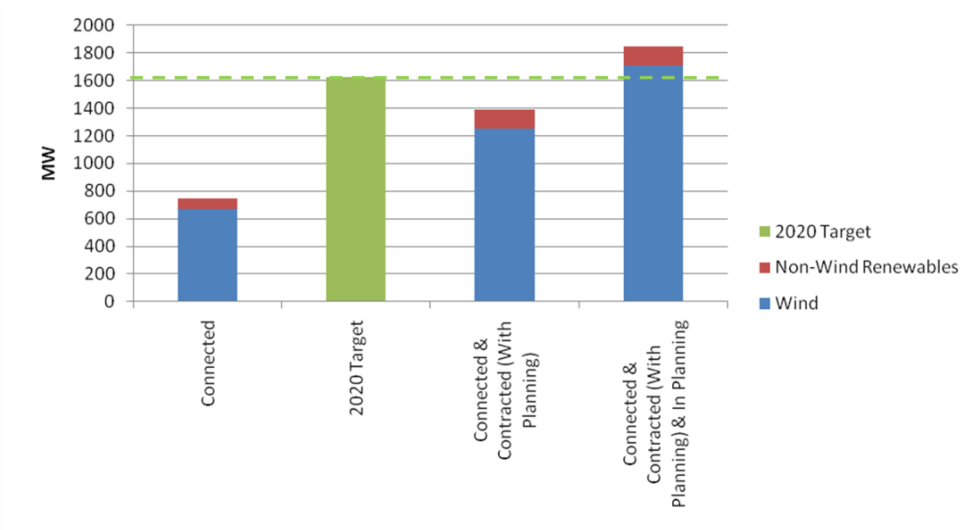


Figure 4: 2020 renewable electricity target, connected capacity and pipeline of wind development in Northern Ireland



MullanGrid's study showed that there will be 5.6GW of wind in Ireland in 2020, including:

- Capacity already connected (2.9GW in total), and
- Capacity with planning consent that is contracted to connect by 2020 (3.7GW in total).

[21] An electrical engineering consultancy specialising in grid connection of renewable generators in Ireland, see http://mullangrid.ie/

The Republic of Ireland that has allocated REFIT support to 3.9GW of wind, though it has only planned 3.6GW wind alongside other renewable resources to meet its 2020 renewable electricity targets. There is rationale for such over-procurement to continue, given the remaining progress that the Republic of Ireland needs to make on its heat and transport targets. Therefore, supporting further wind deployment should be attractive from a political perspective and credible from a delivery perspective.

In light of this evidence, EP considers that installed Irish wind capacity assumptions used in the Pöyry Base Scenario (approximately 4.4GW) is far too low, and has the effect of damaging Greenlink's welfare impacts on GB consumers as it reduces the ability for it to export to GB during the 2020s. Pöyry's assumptions in the High Scenario (approximately 5GW) are more realistic, where Pöyry's model shows that Greenlink delivers strong positive impacts for GB consumers, and a positive impact on GB welfare overall (This positive benefit will be further improved after correcting the Irish market model discussed in section 1.4.).

We estimate that the impact of increasing Irish wind capacity in the Base Scenario to 5GW will produce an improvement in GB consumer welfare of approximately **£59m**, based on the premium/MW of installed wind observed between the Baringa Reference Scenario and Irish Wind Growth CBA results in 2025, used for Greenlink's original submission. Using the same methodology for GB overall welfare, we calculate an improvement of **£35m.**

1.5.3 Wind assumptions in Ofgem/Pöyry's Low Scenario

Finally, we do not believe that the Low Scenario paints a realistic picture of Irish wind deployment, given that Figure 3 and Figure 4 show similar levels of wind deployed in 2015 as the Low Scenario assumes for the year 2020. Further, the scenario seems to assume that the current pipeline of projects will be delayed by a further 15 years, despite the majority of these projects having connection agreements and renewable subsidy support in hand. At worst, we would expect the Low Scenario to reflect the assumptions used for the Base scenario.

1.5.4 Conclusions on Irish wind assumptions in Ofgem modelling

The impacts of the assumptions on Irish wind deployment in 2020 are shown below. There is no impact in the high case as it has been assumed that the Base and High cases have the same starting wind penetration in 2020.

Table 7: Impacts of revised Irish capacity in 2020

	GB Consumer Impacts			GB Producer & I/C Welfare			GB Total Welfare Impacts		
£m NPV, (2013 prices)	Base	Low	High	Base	Low	High	Base	Low	High
Irish Wind Capacity in 2020	59	0	0	35	0	0	94		

1.6 Reduced Irish exports on Moyle to 80MW until at least 2023

We understand from Pöyry's modelling methodology that the Moyle interconnector was assumed to be repaired and operating at 450MW in both import and export directions by 2020, though in its High Scenario it assumed the interconnector would be restricted to 250MW.

However, since at least July 2012 in NGET's TEC and interconnector registers, Moyle's GB import capacity has been reduced to 80MW in 2017, owing to increased renewable generation connecting in south west Scotland, and insufficient available network capacity to handle flows (Figure 5).

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Figure 5: Screenshot from NGET's interconnector register (February 2015)

		MW Current		MW Rate Increase/Decrease		MW Total			
Company	Connection Site	*MW Import	*MW Export	*MW Import	*MW Export	*MW Import	*MW Export	Completion Date	Project Status
Moyle Interconnector Limited	Auchencrosh 275KV	295	295	0	0	295	450		Built
Moyle Interconnector Limited	Auchencrosh 275KV	295	450	-215	0	80	450	10-Nov-17	Built

The limit to Moyle's flows is primarily due to the thermal capacity of the Auchencrosh Kilmarnock single circuit 275kV line which is shared with various generation schemes. There is a further constraint on the Coylton to Kilmarnock circuits with the potential for a loss of >=1800MW on a double circuit fault due to the build-up in generation on these circuits. Figure 6 below shows the Dumfries and Galloway Strategic reinforcement planned by Scottish Power Transmission which could relieve the Moyle restriction. However, this reinforcement is in its early days of consideration. It is not yet listed in the Ofgem DECC Electricity Networks Strategy Group (ENSG) list of projects. The earliest conceivable date for operation of part of the project would be 2023. To release capacity on Moyle above the forthcoming 80MW limit, the reinforcement must reach Auchencrosh, i.e. the full scheme must be built which is extremely unlikely before 2025 and could possibly take much longer.

Figure 6: Information on the Dumfries and Galloway strategic reinforcement required to reinstate full import from Moyle

SP ENERGY NETWORKS Dumfries & Galloway Strategic Reinforcement

POWER CUTS GETTING CONNECTED INVESTMENT ABOUT US CONTACT US

1. The South West area of Scotland is an area rich in renewable energy resources such as onshore wind, offshore wind, hydro and marine. The network is primarily a legacy 132kV active and interconnected system which, along with the 275kV Auchencrosh circuit, is fully committed in terms of generation connections. It is proposed to establish a new 275kV supergrid infrastructure with a reduced 132kV radial network operating as local collector and supply hubs. The aim will be to extend the 275kV network from Harker to Auchencrosh to provide much needed additional capacity to the area for the connection of renewable generation(**SPT-RI-141**).

Dumfries & Galloway Strategic Reinforcement

SP Energy Networks is making a significant investment in the Transmission network in the Dumfries & Galloway area with the modernisation and extension of the supergrid infrastructure.

The existing 132kV network has been unchanged since its construction in the 1930s and has served communities for over 70 years. Significant developments have taken place since then and the needs of the electricity system and its different users have changed in this time. The current network has inadequate capacity and is not fit for purpose, with the assets approaching end of life. We are committed to improving security of supply for existing and future users of this network by making major investment and improvements that will serve users for the next 60-70 year period.

It is proposed to establish a new supergrid infrastructure with a much reduced 132kV network. This will serve the main demand blocks, existing generation portfolios (including the Galloway Hydros) and facilitate the connection of new renewable generation to meet Scotland's energy targets. All of the new infrastructure will be routed with a strong focus on local and environmental needs and sensitivities. This strategic reinforcement will not be a like-for-like replacement of assets. Instead, it will be an investment in a new electricity network infrastructure fit for the needs of the future.We will be taking the opportunity to review the network and remove the infrastructure that is no longer required.

Work has started on this key strategic project through early stakeholder engagement and an environmental assessment. A review of the key network connection points and subsequent local networks is already under way.The outputs from this initial assessment will inform the next stage of the design, including substation location, network design and rationalisation of existing assets.

It is estimated that the project will be completed in 2022/2023.

For more information on the project please contact: majorprojects@spenergynetworks.com

Therefore, at present, the baseline level of interconnection available for GB import from Ireland in 2020 is 580MW, not 1000MW. If Greenlink were to commission in 2020, it would only increase interconnection to 1080MW in the GB import direction, and increase interconnection to 1450MW in the GB export direction.

As interconnection capacity provides diminishing marginal returns, this reduction in available interconnection capacity in the GB import direction will increase the value of Greenlink's flows in the GB direction, particularly during the periods of high wind output discussed in section 1.5, and therefore the impact of Greenlink on GB consumers will be more strongly positive than in a scenario where there is 1450MW of interconnection capacity available in that direction.

Baringa has remodelled the years 2020 and 2025 to calculate the impact that Moyle's reduced flows have on the original CBA submitted as part of Greenlink's cap and floor submission, based on the conservative assumption that the boundary will be reinforced by 2025 to allow Moyle to continue to export at 250MW, and then 450MW by 2030.

The results show that GB consumer welfare in the Reference Scenarios improves by **£13m**. Further, the link's revenues improve by approximately 10% in the first five years of its operation. When applied to Ofgem's modelling, the increase in revenues improves GB total welfare by between **£2.5m** and **£11m**.

1.6.1 Conclusions on Moyle capacity assumptions in Ofgem modelling

The impacts of the restrictions in Moyle import capacity to GB from 2020 are shown in Table 8 below.

Table 8: Impacts of Moyle restrictions on GB imports

	GB Consumer Impacts			GB Producer & I/C Welfare			GB Total Welfare Impacts		
£m NPV, (2013 prices)	Base	Low	High	Base	Low	High	Base	Low	High
Moyle Restrictions	13	13	13	8	3	11	21	16	24

1.7 Electrical losses on Greenlink

The approach to modelling electrical losses in Ofgem's analysis was to model all interconnectors on the Irish border at the same loss factor. Greenlink will have lower electrical losses than the East West interconnector, owing to its shorter distance, higher voltage and more up to date converter technology.

The modelling provided by Baringa for EP's original cap and floor submission shows that Moyle achieves revenues that are around 10% higher than East-West's on a per MW basis, primarily owing to lower lost energy during transmission, but partly supplemented by part-load conditions on the GB-Irish border, which occur when narrow market spreads allow for the dispatch of lower loss interconnectors, but not higher loss interconnectors.

Therefore, as Greenlink's technical design will have lower losses than East-West, its revenues will be higher than those modelled, increasing its performance against any cap and floor that is in place, and delivering higher GB consumer benefit as a result.

Applying this to Ofgem's analysis, we expect that the interconnector welfare would increase by 5% in all scenarios (as a result of interconnector revenues being split across Ireland and GB), with a resulting NPV impact of between **£10m** and **£40m**, differing by scenario.

1.7.1 Conclusions on losses assumptions in Ofgem modelling

The impacts of the lower losses in Greenlink on GB welfare are shown in Table 9 below.

Table 9: Impacts of improved Greenlink losses modelling

	GB Consumer Impacts			GB Producer & I/C Welfare			GB Total Welfare Impacts		
£m NPV, (2013 prices)	Base	Low	High	Base	Low	High	Base	Low	High
Lower Greenlink Losses	0	0	0	30	10	40	30	10	40

1.8 Probabilistic modelling

1.8.1 Background to deterministic modelling approach

The CBA results presented by Pöyry and initial results from Baringa were based upon deterministic modelling, which aims to replicate a "P50" type of world against a specific background of generation and transmission capacity, demand and fossil fuel prices.

For the purposes of the original deterministic modelling, Baringa assumed historically average conditions for the following factors:

- Wind and solar annual load factors;
- Hydro inflow conditions; and
- Plant and interconnector outage rates.

Baringa's deterministic model for Greenlink showed revenues in Baringa's Reference Scenario of:

- €30.2m for 2021 (25.2m Euros for GB imports and 5.1m Euros for GB exports); and
- €37.0m for 2030 (26.6m Euros for GB imports and 10.3m Euros for GB exports)

Effectively, these revenues represent the arbitrage value of the link in a world with average wind, solar, hydro and plant and interconnector availability conditions for a given year – and hence they do not necessarily represent the actual revenues that the link is likely to realise over its lifetime. This is because deterministic models conceptually miss a component of value associated with any asset which can be operated to take advantage of volatile market conditions.

1.8.2 Probabilistic modelling of Greenlink

Probabilistic modelling is more reflective than deterministic modelling of the revenues that are likely to be realised by the project throughout its lifetime, given that it is unlikely that average P50 conditions will be encountered on a year-by-year basis.

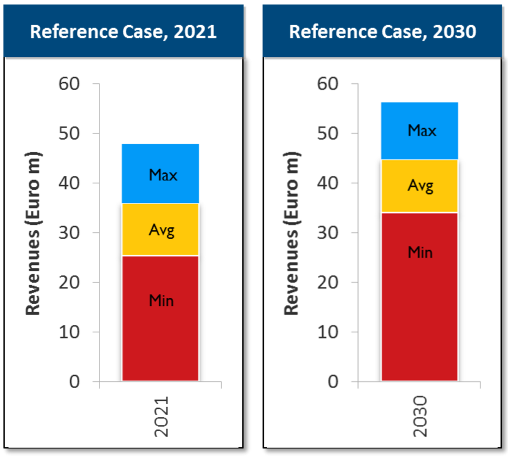
Given that Greenlink's flows are heavily dependent on relative prices in GB and Ireland which will vary according to a number of stochastic factors, EP asked Baringa to conduct a probabilistic analysis on its revenues. Baringa did this by varying the following parameters, mapped against each other to create 50 simulations for the years 2021 and 2030[22]:

- Wind output, as informed by historic years 1998-2012;
- Electricity demand, as informed by historic years 1998-2012;
- Gas and coal price monthly seasonality, as informed by historic years 2007-2012;
- GB and Ireland interconnector outage rates; and
- GB and Ireland coal, gas and nuclear plant outage rates.

[22] Note that this was not submitted as part of EP's original submission to Ofgem

Interconnector revenues from the probabilistic modelling approach are, on average, considerably greater compared to revenues from deterministic modelling (see Figure 7 below) – i.e. around 20% higher across both years. The probabilistic modelling results can also be used to calculate CBA results. The CBA results are around 5% greater (i.e. improved) over the deterministic CBA results.

Figure 7: Impact of probabilistic modelling on Greenlink's revenues in Baringa Reference Scenario



Applying these uplifts to Ofgem's modelling, after the adjustments described to the NGET and Pöyry analysis earlier in this chapter, we estimate the impact to be a benefit of between **£6m** and **£58m** NPV for GB consumers, and between **£16m** and **£66m** for GB overall, depending on scenario.

1.8.3 Conclusions on probabilistic modelling

The impacts of the probabilistic modelling are given in Table 10 below.

Table 10: Impacts of probabilistic modelling of Greenlink

	GB Consumer Impacts			GB Producer & I/C Welfare			GB Total Welfare Impacts		
£m NPV, (2013 prices)	Base	Low	High	Base	Low	High	Base	Low	High
Probabilistic Modelling	34	6	58	49	16	66	83	22	124

1.9 Summary of changes

The changes, corrections and updates described in Sections 1.2 to 1.3 above have a material impact on the forecasts of GB consumer welfare and total GB welfare as summarised and totalled in Table 11.

Table 11: Summary of changes, corrections and updates (before combining with Ofgem results)

	GB Consumer Impacts			GB Producer & I/C Welfare			GB Total Welfare Impacts		
£m NPV, (2013 prices)	Base	Low	High	Base	Low	High	Base	Low	High
Constraints & Intertrip	292	438	147	-1	-1	-1	291	437	146
Ancillary Services	467	400	535	0	0	0	467	400	535
I-SEM SNSP correction	120	0	399	53	0	0	173	0	399
Irish Wind Capacity in 2020	59	0	0	35	0	0	94	0	0
Moyle Restrictions	13	13	13	8	3	11	21	16	24
Lower Greenlink Losses	0	0	0	30	10	40	30	10	40
Probabilistic Modelling	34	6	58	49	16	66	83	22	124
Total impacts	**985**	**857**	**1152**	**174**	**28**	**116**	**1159**	**885**	**1268**

1.10 Impact on Ofgem's analysis

Figure 8 shows Ofgem's summary analysis of Greenlink for GB consumer and GB total welfare with and without Irish Capacity Mechanism payments.

Figure 8: Ofgem's consultation summary of Greenlink GB Consumer and Total Welfare

Table 5: Summary analysis for Greenlink[28] (£m, 2013)

	Base	Low	High
GB wholesale price savings £m NPV	51	-178	147
Impact of cap and floor payments £m NPV	-18	-107	74
Onshore reinforcements costs £m (these are a one-off cost, not discounted over 25yrs)[29]	0	0	0
System operation impacts £m NPV	-292	-438	-146
Total quantified GB consumer impact £m NPV	**-259**	**-724**	**74**
Total quantified GB impact £m NPV	**-337**	**-581**	**1**
Total quantified GB consumer impact £m NPV (with CM)	**-240**	**-690**	**103**
Total quantified GB impact £m NPV (with CM)	**-318**	**-547**	**30**

When the changes corrections and updates are added the welfares are as follows:

Table 12: Revised GB consumer and total welfare

£m NPV, (2013 prices)	Base	Low	High
Total quantified GB consumer impact	726	133	1226
Total quantified GB impact	822	304	1269
Total quantified GB consumer impact (with CM)	745	167	1255
Total quantified GB impact (with CM)	841	338	1298

As a result all the cases are positive welfare for GB consumer and GB overall. When compared to the relatively low investment value of Greenlink, we believe that the case for GB supporting the interconnector is significant.

1.11 Request to Ofgem

In summary, EP does not believe that Ofgem's current assessment of Greenlink is supportable because of the issues identified in this consultation response

Therefore, ahead making its IPA decision on Greenlink, EP requests that Ofgem reconsiders its analysis, in particular removing the constraint costs from the NGET analysis, quantifying the value of ancillary services from Ireland and rerunning the Pöyry model without the SNSP constraint and taking into account the information on Moyle, Greenlink's losses, Irish wind capacity in 2020 and the probabilistic analysis.

As a result EP considers that the result will be close or similar to the calculations provided above, and will present a strong case for Ofgem to award a cap and floor IPA to Greenlink.

2 Response to Ofgem's specific questions

Question 1: Do you agree with our minded-to positions on the four projects considered in this consultation?

EP does not agree with Ofgem's minded-to position on Greenlink, because:

- We have since discussed with NGET that its constraint cost analysis does not accurately portray the Greenlink's impact on the system, given contracted generation background, network reinforcements and transfer capacity calculations, and Greenlink's connection design,
- Greenlink's ancillary service benefits to GB have been omitted, and
- It is based on a modelling methodology which does not reflect the new Irish wholesale market arrangements (I-SEM) as intended by the Irish regulators.

Further, there are additional sources of value that have not been captured by Ofgem's analysis, including:

- the constraint on Moyle's export ability,
- the lower losses on Greenlink and the ensuing benefits; and
- the revenue and welfare impacts revealed from probabilistic modelling.

We have provided more information on these issues in section 1 above.

Question 2: Is there any additional information that you think we should take into account when reaching our decision on the IPA of the projects?

Please see section 1 of this response. We consider that this informs a strong evidence base for Ofgem to update its market modelling and system impacts analysis for Greenlink before reaching its decision on the IPA.

Question 3: What are your views on the approach Pöyry has taken to modelling the impact of cross-border interconnector flows?

While most of Pöyry's modelling methodology is broadly in line with what EP would expect from an interconnector study, EP considers that Pöyry's methodology has not reflected the latest design of I-SEM, which has had the impact of adversely undervaluing Greenlink's revenues and its social welfare impacts. For clarity, we consider that this is an Ireland-only issue, affecting Greenlink only and does not have a significant impact on the other 4 interconnectors' IPAs.

Further, Pöyry's modelling is deterministic and doesn't therefore account for the real variations in assumptions that will play out in reality, (e.g. the availability of a type of generation plant may average 90% but in some instances maybe 100% or 70%). These probabilistic factors have a particularly significant impact on Greenlink as it interconnects two smaller power systems (GB and Ireland) where such factors will be significant in determining power price spreads, (particularly given the levels of wind anticipated on each system).

Given that the IPA decision is so crucial to the successful delivery of future interconnection to GB, and given how significant the analysis is in determining Ofgem's decision, EP believes that Ofgem should have allowed stakeholders the opportunity to comment on the modelling methodologies and assumptions ahead of producing its CBA results.

Question 4: Do you have any additional evidence in this area that we should take into account?

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Our additional evidence is presented in Section 1 above and the associated Annexes.

EP also notes that in Ofgem's own evidence, it publishes a positive total GB welfare result for Greenlink in Table 12 (page 29) of its publication, however it does not seem to acknowledge this in its description of the total GB welfare results in paragraph 4.39.

Question 5: Do you have any views on the information presented in this chapter?

Section 1 of this response sets out the conclusions of our discussions with NGET following the publication of its analysis. To summarise, the constraint costs for Greenlink appear to have been over-estimated as a result of how the analysis represented contracted background generation, network reinforcements, and Greenlink's connection design. As such, Greenlink will not cause constraint costs in 2020, and we ask that Ofgem updates this analysis ahead of forming its decision.

Section 1.3 of this response describes EP's views on ancillary service provision. In summary, we consider that the analysis does not probe deeply enough to consider the benefits of ancillary service provision from Ireland. However, given Greenlink's flow patterns, and the move towards sharing of frequency response between the two markets, we consider that Greenlink would be in a strong position to provide some frequency response to GB in the future and that this will deliver further benefit to GB.

Lastly, we disagree with the way that NGET's analysis has been matched with Pöyry's "Base, High and Low" scenarios. EP understands that NGET's analysis is based upon its Gone Green Scenario, while the Pöyry analysis uses scenarios based upon DECC's Emissions Projections. As is evident in the market modelling, different scenarios can produce very different flows on interconnectors. Therefore EP does not believe it is credible to either combine or net these from each other – they are separate pieces of analysis and should be presented as such.

Question 6: Are there any additional factors that you think we should have considered?

See section 1 of this response for further details of additional factors which form our view for Question 5.

Question 7: Have we appropriately assessed the hard-to-monetise impacts of the interconnectors?

We disagree with paragraph 6.4 which discusses "system meshing", and states "*The benefits offered by Greenlink beyond those associated with generic interconnection are more limited*." There is no analysis to support this statement. The locations of Greenlink, EWIC and Moyle together bridge many National Grid transmission boundaries from Scotland to South Wales with the potential for SOs to divert power via each other's systems to manage bottlenecks, especially at times when the interconnectors are at float. NGET's report supports this by stating "*Opportunities might arise for constraint management involving other interconnectors to Ireland if relevant reinforcements on the onshore Irish network take place and the necessary agreements are made*". Given the operational lifetime of interconnectors it is unreasonable to assume that the necessary reinforcements will not be made and therefore these meshing benefits should be recognised.

Ofgem's comment on generation mix in Figure 2 fails to take account of the diversity in wind generation patterns between Ireland and most of GB, especially with the more geographically dispersed wind projects in the North Sea and northern Scotland.

There is no quantitative analysis to justify the statement "significantly less benefit" in 6.8. Greenlink is smaller in capacity so will deliver smaller benefits, however its length is short compared to the other interconnectors, so it will not have to fund the same levels of capex which improves its performance markedly. When the inaccuracies and omissions in Ofgem's analysis are corrected, it delivers benefits on a similar scale to the other interconnectors.

Greenlink also provides improved security of supply, market integration and GB consumer benefit while the Moyle interconnector's import capacity into Scotland is constrained down to 80MW, as set out in 1.6 of the main body of our response.

Greenlink also has the additional benefit of increasing the diversity of interconnector owners (as stated for FAB Link in paragraph 6.5 of Ofgem's document).

Question 8: Are there any additional impacts of the interconnectors that we should consider qualitatively?

Greenlink provides a greater export market for Irish wind, part of which is based in Northern Ireland and contributes to the UK's legally binding energy targets. EP's own modelling shows that in one scenario, Greenlink allows for an additional 566GWh per annum of wind generation to be produced in Ireland in 2030. This should be considered under UK's legally binding energy targets.

Further, there is no recognition of the importance of interconnection for meeting 2030 EU-wide renewables targets, and whether connecting to another market would enable increased deployment of the most efficient forms of renewable energy to be integrated into the wider European market.

Question 9: Do you have any views on the information presented in this chapter?

The EU has a target of 27% renewable energy target for 2030 and is looking to deliver that from the lowest cost energy sources, of which Irish wind generation will be a key contributor, however Ofgem has not considered or mentioned the EU 2030 target or the importance that interconnection will have in helping to integrate these resources onto the European network.

Further, the consideration of UK targets in comparison to other parts of the document that focus on GB only risks confusing the assessment somewhat. For example, if the quantitative analysis were to account for UK benefits, one would find that Greenlink provides significant benefits to the Northern Irish consumer, which would further improve the results shown in section 1 of our response.

Question 10: Do you have any comments on our assessment of the project plans?

EP does not think that Ofgem's traffic light system is consistently applied. For example, Ofgem flags the lack of a clear regulatory regime in the connecting country for Greenlink as red, despite the fact that the developer has two years to finalise this with the regulatory authorities (i.e. until financial close).

In comparison, Ofgem openly admits that the construction timetable of Viking looks challenging compared to NSN, a similar length interconnector, and implies that it could miss the 2020 deadline that has been set. However, in this case, Ofgem only applies a yellow flag, indicating a "minor concern".

Annex A Background to EP's participation in Ofgem's consultation processes to date

A.1 Submission of Greenlink cap and floor application

EP submitted an application to Ofgem's cap and floor regime on 30 September 2014 for Greenlink, an interconnector between GB and Ireland, rated at 500MW with an option of 700MW. Ofgem decided that Greenlink was eligible to be taken through to the IPA stage of its assessment on 16 October 2014, and said that any IPA decision that may be made would be subject to its existing 2GW generator connection agreement at Pembroke being modified to become an interconnector connection agreement.

Over October and November 2014, the EP Greenlink team worked with Ofgem officials to provide more cost information on the project, and to better understand the results of EP's own CBA that it provided as part of its submission, which was produced by Baringa Partners LLP. On 12 November 2014, the EP team met with Ofgem, and the CER to discuss the CBA results, and on how Ireland intended to process Greenlink for a regulatory regime.

A.2 Following Ofgem's publication of the minded-to position on the NSN IPA, and the Pöyry CBA results

Following the receipt of the cap and floor applications, Ofgem commissioned Pöyry to conduct its own CBA of the impact of all five interconnectors (Greenlink, IFA 2, FAB Link, NSN and Viking Link). On 17 December 2014, Ofgem published Pöyry's results for the Greenlink and the other four interconnectors, and the analysis from the System Operator (SO) NGET Electricity Transmission (NGET) on the impacts of the individual interconnectors on the GB transmission system.

EP expressed significant concern with the market modelling results presented for Greenlink in Ofgem's publication, as they were unexpectedly low both in terms of welfare impacts for GB consumers, and in terms of the link's congestion revenues. For the remainder of December, and into January, EP worked with its advisors to investigate why there were such significant differences between Pöyry's analysis and the CBA that EP had submitted as part of the cap and floor application. Ofgem's working team, Pöyry, EP and Baringa met on 9 January 2015 to discuss the modelling results.

After reconciling the assumptions used in Pöyry's analysis, EP and its advisors discovered that there were two areas that seemed to be influencing Pöyry's modelling results – assumptions on the level of wind in Ireland, and a modelling methodology that was preventing wind from setting the prices in the Irish market.

EP raised these issues in a meeting with Kersti Berge with Ofgem on 29 January 2015, and made a formal submission describing the issues on 30 January 2015 (i.e. within the NSN consultation window). On 17 February 2015, (i.e. after the NSN consultation had closed) Ofgem sent EP a note of confirmation from Pöyry that the two areas that EP identified were correct in driving differences between its study and Baringa's study. Specifically, on its modelling methodology, Pöyry confirmed that it had modelled a constraint in the Irish market in 2020 (named the "System Non-Synchronous Penetration" (SNSP) limit), which prevented wind setting prices in the Irish market. Ofgem also provided this detail in its consultation of 6 March 2015.

The timings of this correspondence with Ofgem and Pöyry relative to the NSN consultation response return date are relevant, because they show that this response is the first formal submission that EP has been able to make since Ofgem released this additional information on its analysis of Greenlink to EP.

As regards the NGET analysis, EP raised concerns and points of clarification this analysis with Ofgem on 22 January 2015. Ofgem held a tripartite meeting with EP and NGET on 5 February to discuss EP's concerns in more detail. EP raised a number of queries to NGET representatives, with particular focus on the underlying system conditions behind the constraint costs being envisaged in NGET's analysis for the year 2020. NGET committed to look into these queries, but did not provide a response to EP until after Ofgem had published its minded-to position on the IPA to Greenlink on 6 March 2015.

A.3 Ofgem's minded-to position on granting Greenlink a cap and floor regime

Ofgem published its minded-to position to not provide Greenlink with a cap and floor regime on 6 March 2015. Since the publication, EP has:

- Provided evidence to Ofgem from new information from the I-SEM market design to demonstrate that the SNSP limit should not be modelled for determining interconnector flows,
- Requested that the Pöyry analysis for Greenlink is updated before Ofgem takes its decision, and
- Asked for all of Pöyry's CBA results, so that it can assess Greenlink's performance in more detail.

Ofgem has steered EP to submit its new information, and its request to update the analysis in this consultation response. Therefore, given the limited information that EP has had in previous consultation windows to comment on the analysis, EP considers that this response is the first opportunity it has been provided to formally respond to the issues that have been identified with Ofgem's analysis.

Annex B Calculation of lost energy from Greenlink intertrip outages (Provided by LR Senergy)

B.1 Introduction

In the event of an N – 2 outage on the circuits out of Pembroke, the generation within the SW2 boundary may exceed the thermal capability of the circuits [1]. In this case, if Greenlink were importing power (to GB), it would be tripped off. This note calculates the expected MWh lost to the GB system as a result.

In the event of an N – 1 failure, the generation will not be inter-tripped.

If the link is exporting power (from GB), it would not be tripped off.

B.2 Circuits

There are two major double circuits (i.e. four circuits) crossing the SW2 boundary; one double circuit from Pembroke to Walham and one double circuit from Swansea North to Cilfynydd. There is a fifth, lower rated circuit but if this were out of service, Greenlink would not need to be tripped.

The circuit length from Pembroke to Walham is 218 km overhead line and 5.5 km underground cable. The length of underground cable is so short, it is not considered in this analysis.

The circuit length from Swansea North to Cilfynydd is 61.6 km, all overhead line.

B.3 Failure Rates

The sustained[23] failure rates for a single and double circuit of onshore overhead line are given in the table below, using date from [2].

Table B1 – Typical National Grid Onshore Circuit Failure Rates

Item	Fault Rate	Mean Down Time
Single circuit onshore overhead line of 100km	0.12 / Year	56 hours
Double circuit onshore overhead line of 100km	0.05 / Year	28 hours

[23] There is also the possibility of a transient failure where the mean down time is given in [2] as a nominal one minute but it is considered that this is not significant when considering overhead line thermal ratings.

B.4 Lost Energy

The average down time for each double circuit is calculated below.

Table B2 – Expected N – 2 Down Time

Circuit	Length	Fault Rate	Down Time / Fault	Down Time/year
Pembroke to Walham Double	218 km	0.109 / Year	28 hours	3.05 hours / Year
Swansea North to Cilfynydd	61.6 km	0.031 / Year	28 hours	0.86 hours / Year
Total				3.91 hours / Year

LR Senergy understands that the importing load factor from Greenlink is expected to be 22%. The link rating is 500MW so average lost energy per annum as a result of the inter-trip is **431MWh**.

N.B.: This is a conservative estimate as it assumes that all of the generation within the SW2 boundary is operating at its maximum output at the time of the N – 2 failure; if there were less generation within the SW2 boundary it would not be necessary to inter-trip Greenlink.

B.5 References

[1] LR Senergy: "Greenlink Boundary Assessment", Project Number PE15EPI001H, v1.0, 27 March 2015.

[2] Offshore Working Group (GSR011) Report: "NETS SQSS", May 2013.

Annex C Relevant excerpts from the Irish regulators' I-SEM building blocks paper

The following excerpt from the Irish regulators' I-SEM Building Blocks consultation document (SEM-15-011, published 11 February 2015), from the section discussing options for managing curtailment of wind (which is generally when there is more wind on the system than can be technically accommodated). The importance of this section to the SNSP constraint is that all options discussed are in the context of adjusting wind output back from the commercial positions reached in the day-ahead, and intraday markets (i.e. cleared volumes of wind). In the European Target Model for electricity market design, the day-ahead market is relevant as the market where interconnector flows will be scheduled and interconnection revenues earned (outside of volumes sold in forward markets).

The same sections also describe that these actions would be performed in the Balancing Mechanism or through cash-out. In other words, it is taken as a given that system constraints such as SNSP are not applied during market trading. Instead, they are managed with system actions by the TSOs outside of these markets, and within the Balancing Mechanism.

Element Power Limited, 2nd Floor Meridien House, 42 Upper Berkeley Street, London, W1H 5QJ, UK

6 TREATMENT OF CURTAILMENT

6.1 INTRODUCTION

In the context of the discussions in this section curtailment generally refers to situations where there is more wind generation available at aggregate level than can be accommodated on the system due to the need to respect, for example, the System Non-Synchronous Penetration (SNSP) limit. In these situations the TSO must turn down a proportion of all wind generation in order to maintain total system security.

The TSOs' Operational Rule for the determination of whether an action is due to a constraint or curtailment is as follows[7]:

- If the Control Centre assumed it had control over every price taking generation unit in tie break on the island of Ireland and the security issue presented could only be resolved by reducing the output of one or a small group of price taking generation units in tie break then that reduction is deemed a constraint and logged as such.
- If the Control Centre assumed it had control over every price taking generation unit in tie break on the island of Ireland and the security issue presented could be resolved by reducing the output of any or all of the price taking generation units in tie break then that reduction is deemed a curtailment and logged as such.

6.2 TREATMENT OF CURTAILMENT IN SEM

In the current SEM there is no distinction between actions taken to relieve constraints and curtailment in terms of settlement to participants. All curtailment actions are treated as constraint actions in settlement. The SEM Committee provided clarity on its curtailment policy in the Decision Paper SEM-13-010:

- Curtailment will be applied pro-rata on all wind generation in the market;
- The TSOs will apply a rule set for distinguishing between constraints and curtailment; and
- From 2018 onwards, wind generation will not be compensated when it is curtailed.

6.3 TREATMENT OF CURTAILMENT IN I-SEM

The specifics of the treatment of curtailment in the I-SEM will be developed as part of the wider development of the detailed balancing market design and therefore at this building blocks stage the intention is to pose a number of questions for discussion which will inform that detailed design.

The SEM Committee is of the view that there are issues within the treatment of curtailment that can be considered ahead of the detailed market design. The section below sets out a number of questions for consideration.

1. How should the SEM Committee decision on curtailment compensation be implemented?

To implement the SEM Committee decision on curtailment compensation it will be necessary to have a mechanism in place to recoup revenues achieved by the wind generator in the DAM, IDM and BM. There are likely two high level approaches that can be taken to achieve this, namely through mandated bidding behaviour or through post processing of generator revenues.

I-SEM is due to go-live in Q4 2017 and the SEM Committee decision on the termination of compensation for curtailment will not apply until Q1 2018. Therefore whatever methodology is chosen to recoup these revenues will not apply for the interim period between I-SEM go-live and 1 January 2018.

Mandated Bidding Behaviour

Wind generators could be required to bid a decremental price into the Balancing Market based on its revenues from the ex-ante markets. All curtailment would be treated as an out of merit dispatch instruction by the TSO, and hence settled at the decremental price submitted.

This would have the advantage of allowing curtailment compensation to be dealt with through generator behaviour rather than in central systems. However, it could be difficult to implement for the generator who would constantly have to have a complex methodology underlying its decremental bid. It could also be difficult to monitor by the relevant authorities.

Cash Out and Post Processing

The second option would be to cash out deviations from DAM and IDM transactions of wind generation in the imbalance market during a curtailment event in the same way as any other generation deviation is cashed out. This would have advantages in that detailed specific rules for tracking of dispatch instructions for curtailment versus constraints would not need to be imported into the core market arrangements and therefore there should be less chance of distortion of the market.

Generators without ex-ante market transactions would be paid the balancing price for their metered generation output, which by definition is net of curtailment. Hence, they would not receive any compensation for the amount of output that was curtailed, and no further settlement rules would be required.

There would be the option to then carry out a form of post processing of generator revenues to take into account the net revenues earned on curtailed volumes (assuming the day-ahead price is higher than the balancing price, when renewable energy plants are curtailed). The post processing would involve consideration of the revenues earned in the DAM and IDM and would therefore require a high level of cooperation and information sharing across the different market timeframes. In the event that the balancing price was higher than the day ahead price then generators would need to be "made whole" for the losses made on their curtailed volumes.

2. Is there a distinction in treatment to be made between trades in the DAM and IDM versus trades which are executed in the BAM or settled in imbalance settlement?

Trades executed in the DAM and IDM are commercial agreements between buyers and sellers to trade electricity and generators notify these positions to the TSOs. Trades executed in the BM or settled in imbalance settlement might be considered differently in that they represent output that was not marketed by its owner and is spilled into the BM or imbalance settlement.

It is therefore worth considering whether the SEM Committee decision on the treatment of curtailment post 2018 should apply differently to DAM and IDM trades than to BM and imbalance settlement output. By treating them differently, this would mean that DAM and IDM trades would be cashed out at the balancing price in a curtailment event and any upside or downside would be retained or borne by the generator.

There are arguments to be made for and against treating the DAM/IDM trades differently.

- The compensation could be significant. In 2013 the total amount of dispatched-down wind generation in Ireland and Northern Ireland was 196GWh of which 72% represented curtailment. Approximately 55% of curtailment occurred overnight between 23:00 and 09:00 when demand levels are lower but prices tend to be lower then also, and approximately 45% occurred during 'day time' hours of 09:00 to 23:00. Therefore in 2013, based on an average overnight SMP of €48.81 and an average 'day time' SMP of €77.72, the cost of compensating curtailment was approximately €8.7m. Further to this it needs to be considered that curtailment levels are expected to increase in future years as the level of installed wind capacity increases. It also needs to be considered that the €8.7m figure may not be directly comparable for I-SEM since the I-SEM context needs to consider the percentage of trades in DAM and IDM versus imbalance settlement.

- However, not compensating for DAM and IDM trades could act as a disincentive for wind to partake in these markets. Were this to be significant, the resulting omission of zero marginal cost wind from the DAM could act to increase the DAM price. The demand in 2013 for example was circa 33 TWh. Were, for example, reduced participation in the DAM and IDM to increase prices by €1/MWh the total cost to the market would be circa €33m.

- It is extremely difficult to quantify the potential cost of compensating DAM and IDM trades versus the potential increase in DAM costs by lower participation of wind generation.

- Creating disincentives to trade in the DAM could affect the liquidity of that market and could ultimately have detrimental effects on the integrity of price formation.

6.4 SUMMARY

In summary, two options are proposed in respect of how the SEM Committee decision on compensation for curtailment should be implemented in I-SEM.

- The first would mandate a bidding behaviour on wind generators whereby they would be required to bid a decremental price into the Balancing Market based on their revenues from the ex-ante markets.
- The second option would involve cashing out the generator in a curtailment event in the same way as any other generator deviations are cashed out, followed by the option to carry out post processing where the prices in the ex-ante markets are higher than the BM prices for the curtailed energy. In the event that the balancing price was higher than the day ahead price then generators would need to be "made whole" for the losses made on their curtailed volumes.

The SEM Committee has also put forward for discussion whether the decision on the treatment of curtailment post 2018 should apply differently to DAM and IDM trades than to BM and imbalance settlement output.

Element Power Limited, 2nd Floor Meridien House, 42 Upper Berkeley Street, London, W1H 5QJ, UK

Annex D Relevant excerpts from EirGrid's I-SEM modelling methodology

The following excerpts are from EirGrid's I-SEM modelling methodology document, where, to accurately reflect the design of the I-SEM, EirGrid explicitly sets out that operational constraints (including SNSP) are included in the balancing mechanism components of the model. This reinforces that the SNSP constraint should be kept outside of the market modelling.

10. OPERATIONAL CONSTRAINTS

The following indicative operational constraints are included in the BM components of the model. It should be emphasised that these operational constraints are included to understand the potential impact on the dynamics of the I-SEM of the presence of system constraints in the balancing market, and should not be taken to be a forecast of operational constraints on the system.

Operational reserve, system non-synchronous penetration (SNSP), Min Sets Transmission Constraint Groups (TCGs) and a minimum inertia requirement are modelled in the NEB and EB models. For the base case, no constraints are included in the DAM model.

SNSP is assumed to be 75%, and is modelled through the following constraint rule in the model:

$$\text{SNSP Limit} \geq \frac{\text{All Island Wind Generation} + \text{Interconnector Imports}}{\text{All Island Demand} + \text{Interconnector Exports}}$$

The following reserve items are modelled, with the following assumptions:

- Primary Operating Reserve Spinning (Min Provision 160MW day, 125MW night)
- Primary Operating Reserve Total. Total requirement 75% of Largest Single Infeed (LSI). It is assumed that the Short Term Active Response (STAR) scheme provides 45MW of reserve.
- Secondary Operating Reserve. Total requirement 75% of Largest Single Infeed (LSI)
- Tertiary Operating Reserve 1. Total requirement 100% of Largest Single Infeed (LSI)
- Tertiary Operating Reserve 2. Total requirement 100% of Largest Single Infeed (LSI)
- An inertia requirement of 20GW on the SEM system

The Minimum Number of Units TCGs are modelled under the following rules:

- IE: 5 Min Sets, from CCGT and Coal plants
- NI: 2 Min Sets, from CCGT and Coal plants

Current operational constraints are published on the EirGrid website (http://www.eirgrid.com/operations/dispatchbalancingcosts/operationalconstraints/), with estimates of changes included in the model to reduce complexity and represent the general direction of changes in the future as opposed to forecasted changes by a particular year.

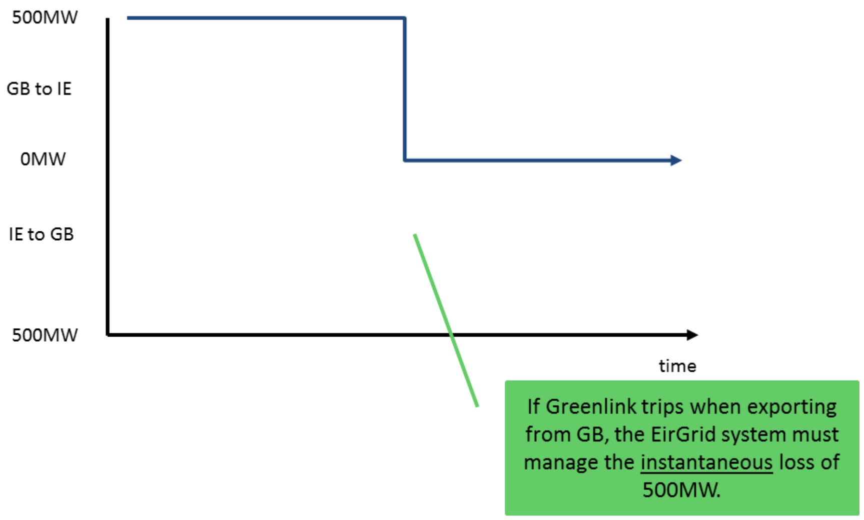
Element Power Limited, 2nd Floor Meridien House, 42 Upper Berkeley Street, London, W1H 5QJ, UK

Annex E Ancillary service provision from Greenlink

E.1 Can Greenlink provide fast frequency response from the Irish system?

We consider that Greenlink should be well capable of providing frequency response from the Irish system without posing any security of supply problems to the system. This is illustrated in F1 below.

Figure F1: Illustration of impact of loss of Greenlink on Irish system



Compared to the impact of an instantaneous loss, the ability to manage a small amount of fast frequency response is far lower-impact to handle for the Irish SO.

Figure F2: Illustration of impact of fast frequency response compared to instantaneous loss