# AN UPDATE OF HISTORICAL DE-RATING FACTORS FOR GB INTERCONNECTORS

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# SUMMARY OF APPLIED APPROACH AND UPDATED DE-RATING FACTORS

| | Relevant periods | Applied metrics | Applied metrics |
|---|---|---|---|
| **Applied approach** | • Highest 50% of GB peak demand periods during winter quarter<br>• Time series of last 7 years | **Existing interconnectors:** Contribution to de-rating factor only when day-ahead price differentials are positive and GB is importing electricity | **New interconnectors:** Contribution to de-rating factor when day-ahead price differentials are positive |

## Historical de-rating factors of existing and new interconnectors

Highest 50% of peak demand periods during winter quarter (7am-7pm business days, Dec 2012- Feb 2019, 2656 total relevant periods)

| DRF calculations based on: | Interconnector between GB and: | | | | | |
|---|---|---|---|---|---|---|
| | France | Ireland | Netherlands | Belgium | Norway (NO2/NO5) | Denmark |
| Price differential (+ve i.e. GB price > price in Interconnected Market) | | | | 68% | 97% | 95% |
| Price differential (+ve) & GB imports | 62% | 8% | 75% | | | |

- In line with the requirements of the Capacity Market (amendments) Rules (2015), interconnectors to Belgium, Norway and Denmark are treated as new interconnectors as they do not yet have seven complete years of operational data. Their de-rating factors are based only on price differentials during the relevant periods.
- The de-rating factors of new interconnectors are before any adjustments for technical reliability and losses. As proposed in the original study and in the 2017 Update, these de-rating factors will need adjustment for technical reliability (including ramping) and a minimum positive price differential threshold to compensate transmission losses.

# KEY FINDINGS

- In general, the historical de-rating factors for interconnectors have increased when based on the latest seven years time series i.e. Dec 2012 – Feb 2019.

| DRF based on: | Interconnector between GB and: | | | | | | |
|---|---|---|---|---|---|---|---|
| | France | Ireland | Netherlands | Belgium[2] | Norway[2] | Denmark[2] | Germany[2] |
| Feb. 2015 Study (time series: **2008-2013**) | 29% | 2% | 62% | 58% | 74% | Not part of the study scope | Not part of the study scope |
| May 2016 Update (time series: **2009-2015**) | 45% | 2% | 70% | 65% | 76% | | |
| April 2017 Update (time series: **2010-2016**) | 48% | 4% | 75% | 65% | 85% | 87% | |
| April 2018 Update (time series: **2011-2017**) | 55% | 5% | 70%[1] | 67% | 96% | 93% | 82% |
| June 2019 Update (time series: **2012-2018**) | 62% | 8% | 75%[1] | 68% | 97% | 95% | Not part of the study scope |

- The increase in de-rating factors is mainly driven by the removal of the low 2011/12 DRFs from the seven-year time series.
- The annual 2018 DRF for Ireland has increased, with a noticeable improvement in the correlation of flows and price differentials between the two markets in the last year with the beginning of I-SEM. The average over the last seven years is still weighted down by pre I-SEM historical data.
- The annual 2018 DRF for France has slightly increased, although it is still weighted down by the market related issues in 2016, which were not related to the efficiencies of the flows.

1 DRF for interconnector to the Netherlands include in the April 2018/2019 Updates both price differentials and flows

2 DRFs for interconnectors to Belgium, Norway, Denmark and Germany are based on price differentials only.

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# BACKGROUND

- A GB capacity market was introduced in December 2014. The Capacity Market is designed to ensure that security of electricity supply is maintained for GB consumers, while offering rewards for those capacity providers most economically able to contribute towards security of supply.
- All capacity participating in the auction has a de-rating factor applied.
- New and existing interconnectors were eligible to participate in the December 2015 auction for capacity in 2019/20.
- BEIS (former DECC) commissioned Pöyry in January 2015 to develop an approach based on historical evidence to derive conservative estimates of the de-rating factor of interconnectors applicable to both existing and new interconnectors to GB[1].
- Pöyry has undertaken analysis to update the historical de-rating factors for subsequent auctions in line with the methodology as set out in the Capacity Market Rules[2].
- In May 2019, BEIS asked Pöyry to update the historical de-rating factors including the latest 2018 data, while applying the methodology as set out in the Capacity Market Rules[2].
- In accordance with the Capacity Market Rules, the updated de-rating factors presented in this report are based on the average of the latest seven years (2012-2018) annual de-rating factors. However, for new interconnectors no adjustments are made in their de-rating factors for the technical reliability and losses.
- Any revision to, or update of, the methodology proposed in the original study (in January 2015) is outside the scope of this project.

1 The details of the developed methodology and implied de-rating factors of interconnectors are available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/404337/Final_historical_derating_of_IC_poyry_report.pdf

2 Consolidated version of the capacity market rules (July 2016), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/538235/Informal_consolidation_of_Capacity_Market_Rules_July_2016.pdf

# DEFINITIONS

- **De-rating factor (DRF)**: The de-rating factor is the percentage of time when GB is expected to be importing electricity from an interconnector during identified system stress periods.
  - DRF represents the capacity credit of an interconnector. For example, a 90% de-rating factor of an interconnector will mean that 90% of the time it is available to provide electricity imports to GB from the connected market during GB system stress periods.
  - High DRF of an interconnector means that it can provide more of its capacity to support GB security of supply during system stress periods.

– **Relevant periods**: These are the chosen periods within a year when the behaviour of an interconnector is examined for assessing its de-rating factor – i.e. highest 50% of GB peak demand periods during the winter quarter (7am-7pm business days, Dec-Feb).

– **Existing interconnectors**: Interconnectors to France, Ireland and the Netherlands are described as existing interconnectors as they have operational data covering the seven years for which the relevant periods are defined.

– **New interconnectors**: Interconnectors which have less than seven years operational data or are not currently operational, but may be within the timescale of the Capacity Market auction – i.e. interconnectors to Belgium, Denmark, and Norway are described as new.

– **Yearly data**: One year represents the 12 month period from 1 April to 31 March in order to include one complete winter season – e.g. 2018 data will include 1 April 2018 to 31 March 2019 period.

# DATA SOURCES

## Historical demand and interconnector flows

| Data | Period | Source |
|---|---|---|
| Electricity demand | Apr 2008 – March 2019 | National Grid UK |
| Interconnector flows | Apr 2008 – March 2019 | National Grid UK |

## Historical electricity price data sources

| Market | Period | Source (power exchange) |
|---|---|---|
| Great Britain | Apr 2008 – Oct 2011 | APX UK for within day prices and Heren day-ahead price index |
| Great Britain | Nov 2011 – March 2019 | N2EX for day-ahead prices |
| France | Apr 2008 – March 2019 | EPEX (former Powernext) for day-ahead prices |
| Netherlands | Apr 2008 – March 2019 | APX Netherlands for day-ahead prices |
| Ireland | Apr 2008 – March 2018 | SEMO Ireland for day-ahead prices |
| Ireland | Apr 2018 – March 2019 | ENTSO-E transparency platform |
| Belgium | Apr 2008 – March 2019 | Belpex for day-ahead prices |
| Norway and Denmark | Apr 2008 – March 2019 | Nordpool for day-ahead prices |

## Other assumptions

- The currency conversion rates (for each day) are adopted from ThomsonReuters

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# APPLIED METHODOLOGY

**We have applied the methodology for estimating conservative estimates of de-rating factors as proposed in the original study for BEIS (former DECC) conducted in Jan-Feb 2015[1] and adopted in the Capacity Market rules. This methodology determines the extent to which an existing interconnector has (or a future interconnector would have potentially) contributed to GB security.**

| Steps involved | Metrics for computing historical DRF | Rationale |
|---|---|---|
| 1 Choice of criteria that represents GB system tightness | **GB electricity demand** | GB demand level has strong correlation with GB system stress conditions and demand data is readily available to apply this criteria in identifying stress periods. |
| 2 Define threshold for metric to identify periods when GB system was stressed | **Time series:** 2012-2018<br>**Within year window:** winter quarter (December to February)<br>**Ranking characteristic:** GB peak demand periods i.e. 7am to 7pm GMT during business days<br>**Relevant periods:** highest 50 % of GB peak demand periods | Historically system stress periods have mainly occurred during winter peak demand conditions. Use of a larger number of periods in a year generally provides more conservative and more significant statistical estimates of DRFs. |
| 3 Choice of metric for IC de-rating calculation | **IC flows**: The direction of IC flows during system stress periods define if an interconnector was contributing to GB system<br>**Price differentials**: Lower prices in neighbouring countries than GB favour GB – presumption is that IC flows would follow price differentials | A tighter (stressed) system would expect relatively high prices hence imports from connected countries.<br>There is good data availability of both interconnector flow data and day-ahead electricity prices to apply this metric. |
| 4 Calculating DRFs | **Existing IC:** Divide the number of periods when price differentials were positive (i.e. GB prices > prices in other markets) and GB was importing during the relevant periods by the total number of relevant periods<br>**New IC:** Divide the number of periods when price differentials were positive during the relevant periods by the total number of relevant periods | The DRF is based on 'efficient behaviour' of interconnectors when imports coincide with a positive price differential (i.e. GB electricity price > price in the connected market). Only price differentials are available for new interconnectors. |

The use of highest 50% peak demand periods in winter quarter and 7 years time series is consistent with the Capacity Market Rules (2015).

1 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/404337/Final_historical_derating_of_IC_poyry_report.pdf

# PROS AND CONS OF APPLIED APPROACH FOR EXISTING ICs

**Using highest 50% peak demand periods in winter quarter (for the latest 7 years time series) and applying imports and price differentials to determine the DRF of existing interconnectors has the following advantages:**

- it provides consistency with the timeframe for DRF assessment of conventional generation in the Capacity Market auction;
- for existing interconnectors, it represents those periods when the interconnectors were operating efficiently (i.e. the flow direction was following the price differentials between the connected markets) and actually contributing to GB security rather than relying on an assumption of how we expect them to operate (i.e. considering price differentials only);
- it incorporates technical availability for existing interconnectors; and
- it captures the interactions between different interconnectors (i.e. if the interconnectors are competing at the margin to supply GB) and of system tightness conditions in GB and the connected markets.

**Some issues related to the applied approach include:**

- the high number of periods analysed in each year is likely to capture non-stress periods; and
- a straight arithmetic average over the period may give too high a weighting to earlier years when there were more market distortions, therefore underetimating the likely contribution under near term future market conditions.

# PROS AND CONS OF APPLIED APPROACH FOR NEW ICs

**Using highest 50% peak demand periods in winter quarter (for recent 7 years of time series) and applying price differentials to determine the DRF of new interconnectors has the following advantages:**

- it provides consistency with the timeframe for DRF assessment of conventional generation in the Capacity Market auction; and
- it reflects the expectation that market coupling will be more embedded and efficient by the time these come into operation.

**Some issues related to the applied approach include:**

- future policy or regulatory changes affecting market behaviour will not be captured as the DRFs are based on 'historical' price trends in connected markets though these can be captured in the rest of the de-rating process;
- it can not capture the interactions between interconnectors and of system tightness conditions in GB and the future connected markets – the physical existence of new interconnectors can alter pricing dynamics and historical price differential based DRFs may overstate contribution of interconnectors at times of system stress;
- it does not incorporate the technical availability and ramping of new interconnectors (post commissioning date) requiring adjustment to DRFs; and
- the DRFs do not account for the impact of losses on cross-border flows – i.e. a minimum positive price differential may be appropriate to reflect transmission losses across the interconnector.

Note: Nevertheless, annual calculations for the Netherlands on existing and new basis have not varied significantly, so this may not be a major issue

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# DRFS FOR GB-FRANCE INTERCONNECTION

**In 2018, DRF back to levels observed in 2013 after a substantial dip for 2016; due to low nuclear generation availability in France during the winter quarter, electricity prices were high relative to GB during most of the relevant periods resulting in a very low DRF of 25% in 2016**

**Average annual DRF based on 50% of peak demand periods during winter quarter**
(7am-7pm business days, Dec-Feb)

| DRF calculations based on: | Annual | | | | | | | | | | Average of recent 7 years |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2012-2018 |
| Price differential (+ve i.e. GB price > price in France) | 14% | 55% | 57% | 79% | 80% | 70% | 79% | 28% | 71% | 75% | 69% |
| GB Imports | 1% | 29% | 32% | 59% | 76% | 97% | 91% | 30% | 72% | 80% | 72% |
| Price differential (+ve) & GB Imports | 1% | 20% | 26% | 50% | 68% | 69% | 79% | 25% | 70% | 74% | **62%** |

DRF for 2016 was significantly low due to market conditions in France.
Average DRF for 2018 has increased due to the substitution of 2011 annual DRF (26%) by 2018 DRF (74%).

**Average annual DRF based on different number of peak demand periods during winter quarter**
**(7am-7pm business days, Dec-Feb, April 2012 to March 2019)**

| DRF calculations based on: | Relevant peak demand periods | | | |
|---|---|---|---|---|
| | 5% | 10% | 25% | 50% |
| | 274 | 539 | 1337 | 2656 |
| Price differential (+ve) | 79% | 77% | 70% | 69% |
| GB imports | 73% | 74% | 72% | 72% |
| Price differential (+ve) & GB Imports | 69% | 69% | 62% | **62%** |

Using a larger number of periods in a year generally reduces DRFs.

The choice of number of 'relevant periods' in a year involves a trade-off between statistical significance and capturing representative interconnector behaviour under system stress conditions (as larger data set captures 'normal' or 'slack' conditions).

# DRFS FOR GB-IRELAND INTERCONNECTION

**The launch of I-SEM had a significant positive impact on the operations of cross border flows. However, the 7 years average and stronger observed price signals for flows to IAI during GB stress times result in an overall low DRF.**

**Average annual DRF based on 50% of peak demand periods during winter quarter**
(7am-7pm business days, Dec-Feb)

| DRF calculations based on: | Annual | | | | | | | | | | Average of recent 7 years |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2012-2018 |
| Price differential (+ve i.e. GB price > price in Ireland) | 9% | 29% | 12% | 14% | 17% | 34% | 47% | 37% | 43% | 27% | 31% |
| GB Imports | 0% | 0% | 4% | 6% | 17% | 0% | 16% | 32% | 12% | 27% | 15% |
| Price differential (+ve) & GB Imports | 0% | 0% | 2% | 0% | 3% | 0% | 12% | 13% | 9% | 25% | **8%** |

In FY2018, convergence of the levels based on prices and flows when considered seperately

In FY2018, GB prices were higher than prices in Ireland (SEM) for less than 30% of the relevant periods, resulting in a DRF of GB-Ireland interconnection as low as 25% despite the substantial increase in economically rational flows.

**Average annual DRF based on different number of peak demand periods during winter quarter**
**(7am-7pm business days, Dec-Feb, April 2012 to March 2019)**

| DRF calculations based on: | Relevant peak demand periods | | | |
|---|---|---|---|---|
| | 5% | 10% | 25% | 50% |
| | 274 | 539 | 1337 | 2656 |
| Price differential (+ve) | 35% | 33% | 31% | 31% |
| GB imports | 10% | 9% | 12% | 15% |
| Price differential (+ve) & GB Imports | 7% | 6% | 7% | **8%** |

Note: The average wholesale electricity price in 2018 in IAI was 68€/MWh, 14€/MWh higher than the previous year, driven mostly by higher gas prices

# DRFS FOR GB-NETHERLANDS INTERCONNECTION

**2017 was the first year there is a complete 7 years of operational data for the GB-Netherlands interconnector. DRF back to levels observed in 2015 despite price signals across the markets less in favour of GB during stress time**

**Average annual DRF based on 50% of peak demand periods during winter quarter**
(7am-7pm business days, Dec-Feb)

| DRF calculations based on: | Annual | | | | | | | | | | Average of recent 7 years |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *2009* | *2010* | *2011* | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2012-2018** |
| Price differential (+ve i.e. GB price > price in Ireland) | *31%* | *58%* | *68%* | 78% | 84% | 83% | 89% | 64% | 93% | 78%[1] | 81% |
| GB Imports | *n/a* | *n/a* | *37%* | 71% | 87% | 99% | 97% | 70% | 92% | 74% | 84% |
| Price differential (+ve) & GB Imports | *n/a* | *n/a* | *31%* | 57% | 75% | 83% | 90% | 63% | 91% | 70% | **75%** |

In 2016, the reduced regional capacity margins (due to lower availability of the French Nuclear fleet) also affected the electricity prices in the Dutch market. However, this effect was lesser than in countries directly connected to France.

In 2018, the DRF calculated as an "existing" interconnector is lower than when considered "new", but mostly due to the first couple of years (2011-2012)

**Average annual DRF based on different number of peak demand periods during winter quarter (7am-7pm business days, Dec-Feb, April 2011 to March 2018)**

| DRF calculations based on: | Relevant peak demand periods | | | |
|---|---|---|---|---|
| | **5%** | **10%** | **25%** | **50%** |
| | 274 | 539 | 1337 | 2656 |
| Price differential (+ve) | 90% | 89% | 84% | 81% |
| GB imports | 85% | 87% | 87% | 84% |
| Price differential (+ve) & GB Imports | 80% | 82% | 78% | **75%** |

1 Dutch day-ahead prices increased compared with the previous year, driven by higher carbon price and a tight capacity situation in Belgium

# DRFS FOR GB-BELGIUM INTERCONNECTION

**The DRF of GB- Belgium interconnection in 2017 back to levels observed prior to 2016**
**NEMO started its commercial operations in 2019**

**Now online**

**Average annual DRF based on 50% of peak demand periods during winter quarter**
(7am-7pm business days, Dec-Feb)

| DRF calculations based on: | Annual | | | | | | | | | | Average of recent 7 years |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *2009* | *2010* | *2011* | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2012-2018 |
| Price differential (+ve i.e. GB price > price in Belgium) | *27%* | *59%* | *63%* | 64% | 75% | 79% | 87% | 31% | 70% | 70% | **68%** |
| GB Imports | n/a | | | | | | | | | | |
| Price differential (+ve) & GB Imports | | | | | | | | | | | |

In 2016, the number of positive price differential periods between the GB and Belgium markets significantly decreased. This was mainly due to the dependence of the Belgian market on the French market – their interconnector has a net transfer capacity of 1850MW from France to Belgium.

**Average annual DRF based on different number of peak demand periods during winter quarter**
**(7am-7pm business days, Dec-Feb, April 2012 to March 2019)**

| DRF calculations based on: | Relevant peak demand periods | | | |
|---|---|---|---|---|
| | 5% | 10% | 25% | 50% |
| | 274 | 539 | 1337 | 2656 |
| Price differential (+ve) | 81% | 79% | 71% | **68%** |
| GB imports | n/a | | | |
| Price differential (+ve) & GB Imports | | | | |

In line with the requirements of the Capacity Market (amendments) Rules (2015), the existing interconnector to Belgium is treated as a new interconnector because it does not have complete seven years of operational data. Therefore, its DRF is based on only positive price differentials during the relevant periods.

# DRFS FOR GB-NORWAY2 INTERCONNECTION

**DRF of GB-Norway interconnection remains very high as hydro based historical electricity prices in Norway during the relevant system stress periods in GB remain lower than the GB prices.**

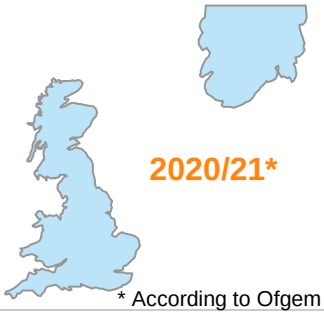
**Average annual DRF based on 50% of peak demand periods during winter quarter**
(7am-7pm business days, Dec-Feb)

| DRF calculations based on: | Annual | | | | | | | | | | Average of recent 7 years |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *2009* | *2010* | *2011* | ***2012*** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2012-2018** |
| Price differential (+ve i.e. GB price > price in Norway) | *38%* | *51%* | *91%* | 94% | 99% | 99% | 93% | 100% | 99% | 96% | **97%** |
| GB Imports | n/a | | | | | | | | | | |
| Price differential (+ve) & GB Imports | | | | | | | | | | | |

After a drop in DRF in 2015, driven by several unusual cold spells in Norway, the DRF in 2016 increased again as electricity prices in Norway were predominantly lower than in GB due to warmer winter conditions (average winter temperature in Norway was higher than the seasonal norm during 2016/17 winter).

**Average annual DRF based on different number of peak demand periods during winter quarter**
**(7am-7pm business days, Dec-Feb, April 2012 to March 2019)**

| DRF calculations based on: | Relevant peak demand periods | | | |
|---|---|---|---|---|
| | **5%** | **10%** | **25%** | **50%** |
| | 274 | 539 | 1337 | 2656 |
| Price differential (+ve) | 97% | 97% | 96% | **97%** |
| GB imports | n/a | | | |
| Price differential (+ve) & GB Imports | | | | |



**2020/21***

* According to Ofgem

Note: calendar year 2010 (inc. Q1) started with low hydro reservoir levels and issues of nuclear production in Sweden, driving up the wholesale prices in the region

# DRFS FOR GB-NORWAY5 INTERCONNECTION

**DRF of GB-Norway[1] interconnection remains very high as hydro based historical electricity prices in Norway during the relevant system stress periods in GB remain lower than the GB prices.**

**Average annual DRF based on 50% of peak demand periods during winter quarter**
(7am-7pm business days, Dec-Feb)

| DRF calculations based on: | Annual | | | | | | | | | | Average of recent 7 years |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *2009* | *2010* | *2011* | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2012-2018 |
| Price differential (+ve i.e. GB price > price in Norway) | *n/a* | *35%* | *89%* | 92% | 100% | 99% | 93% | 100% | 99% | 96% | **97%** |
| GB Imports | n/a | | | | | | | | | | |
| Price differential (+ve) & GB Imports | | | | | | | | | | | |

After a drop in DRF in 2015, driven by several unusual cold spells in Norway, the DRF in 2016 increased again as electricity prices in Norway were predominantly lower than in GB due to warmer winter conditions (average winter temperature in Norway was higher than the seasonal norm during 2016/17 winter).

**Average annual DRF based on different number of peak demand periods during winter quarter**
**(7am-7pm business days, Dec-Feb, April 2012 to March 2019)**

| DRF calculations based on: | Relevant peak demand periods | | | |
|---|---|---|---|---|
| | 5% | 10% | 25% | 50% |
| | 274 | 539 | 1337 | 2656 |
| Price differential (+ve) | 97% | 97% | 96% | **97%** |
| GB imports | n/a | | | |
| Price differential (+ve) & GB Imports | | | | |


1 Price difference between NO2 and NO5 is significantly smaller than the differential with GB

# DRFS FOR GB-DENMARK INTERCONNECTION

**Price differential based DRF of Danish interconnection is very high as electricity prices in Denmark are influenced by low prices in Norway.**

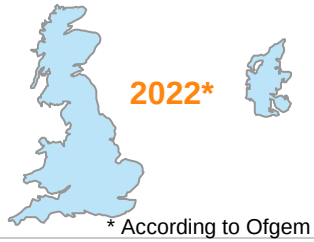
**Average annual DRF based on 50% of peak demand periods during winter quarter**
(7am-7pm business days, Dec-Feb)

| DRF calculations based on: | Annual | | | | | | | | | | Average of recent 7 years |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *2009* | *2010* | *2011* | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2012-2018 |
| Price differential (+ve i.e. GB price > price in Norway) | *43%* | *58%* | *84%* | 88% | 97% | 94% | 92% | 97% | 99% | 95% | **95%** |
| GB Imports | n/a | | | | | | | | | | |
| Price differential (+ve) & GB Imports | | | | | | | | | | | |

The substitution of 2011 annual DRF (84%) by 2018 DRF (95%) results in an increase in the average DRF of the latest 7 years time series.

**Average annual DRF based on different number of peak demand periods during winter quarter**
**(7am-7pm business days, Dec-Feb, April 2012 to March 2019)**

| DRF calculations based on: | Relevant peak demand periods | | | |
|---|---|---|---|---|
| | 5% | 10% | 25% | 50% |
| | 274 | 539 | 1337 | 2656 |
| Price differential (+ve) | 96% | 97% | 94% | **95%** |
| GB imports | n/a | | | |
| Price differential (+ve) & GB Imports | | | | |

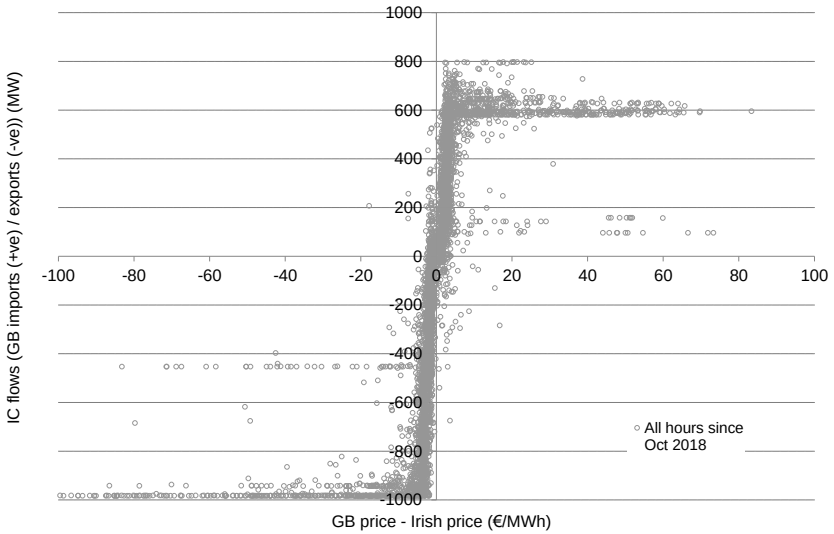



* According to Ofgem

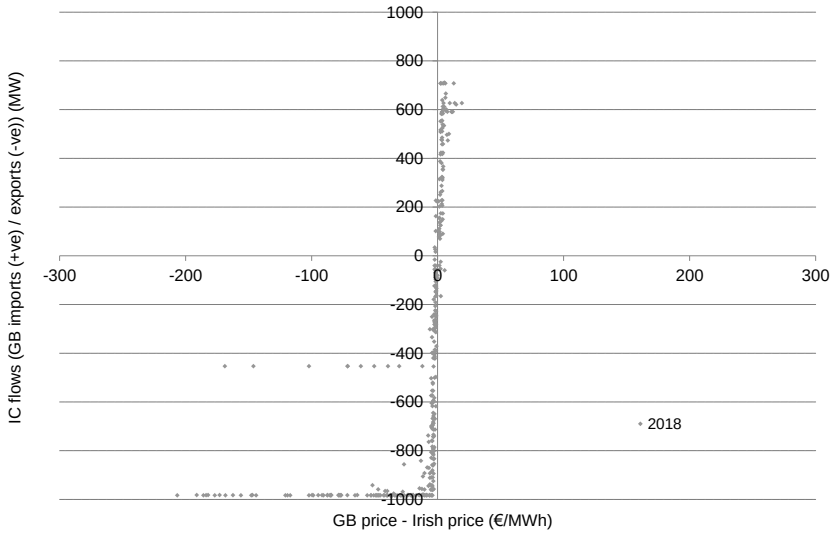
# TRANSITION FROM SEM TO I-SEM

## With the introduction of I-SEM in October 2018, cross border flows between IAI and Great Britain follow price signals better

### Example 1: GBR-I-SEM (all hours) from Oct 18



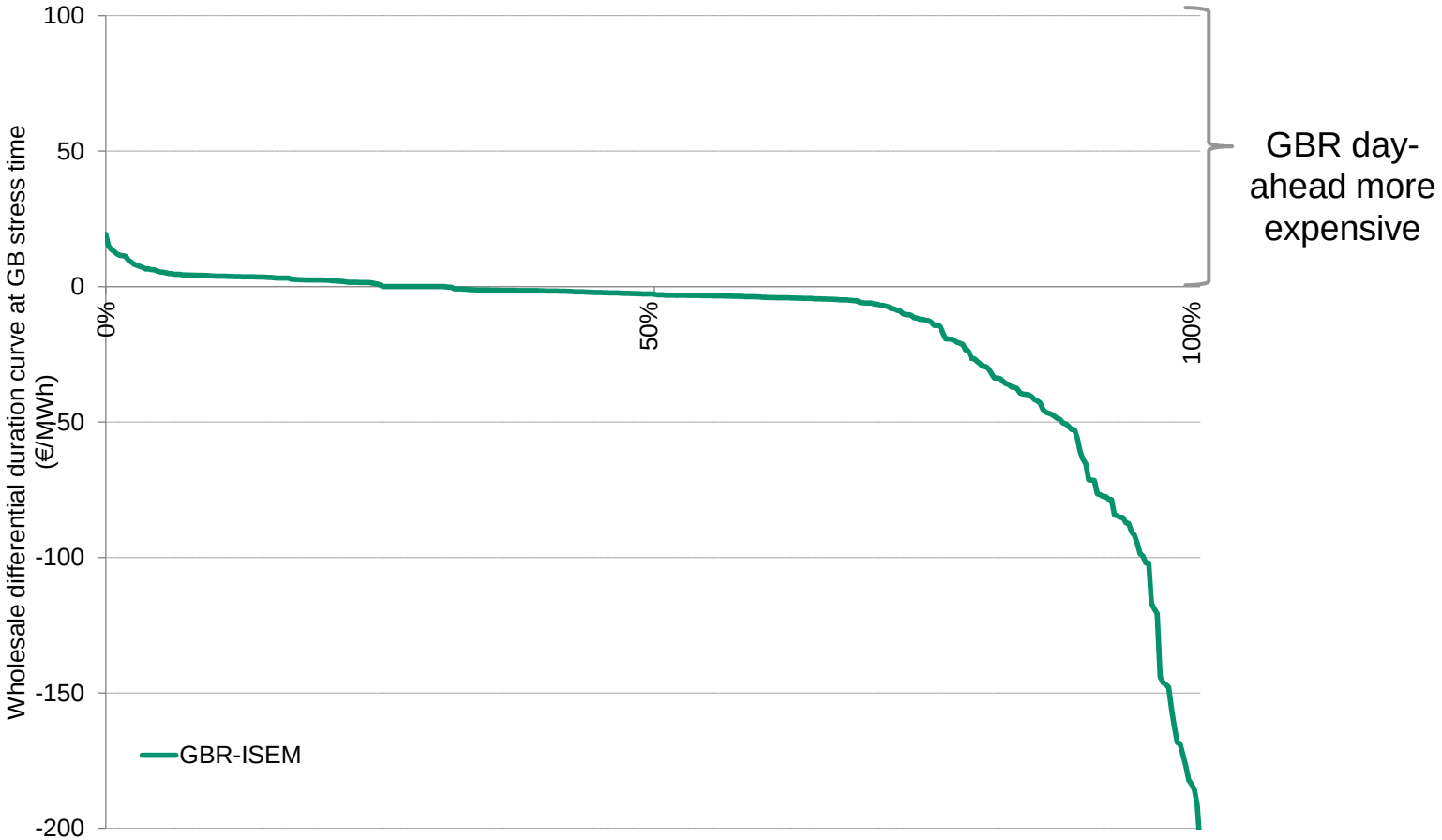

### Example 2: GBR-I-SEM (hours of interest)




- The Ireland All-Island revised set of market arrangements, often called the Integrated Single Electricity Market (I-SEM) arrangements, went live on 1 October 2018;
- One of the aims of the new market arrangements was to rationalise the direction of interconnector flows so that flows followed price signals better;
- Example 1 shows clear patterns synonymous of economically rational flows in both directions;
- However, as shown in example 2, during the relevant periods here (identified system stress in Great Britain), the market prices were mostly calling for flows to I-SEM.

# GB – I-SEM PRICE DIFFERENTIAL DISTRIBUTION

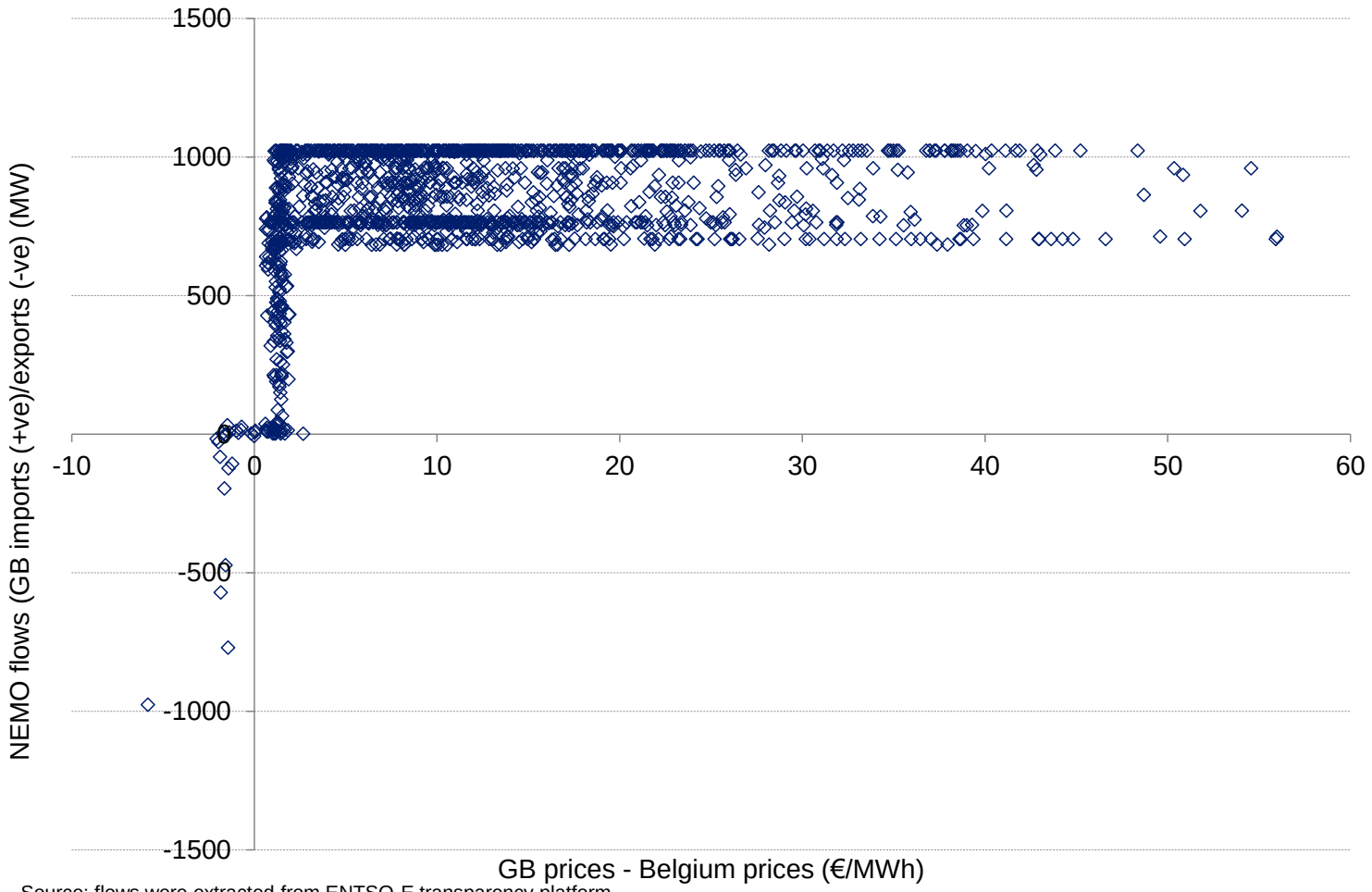
## For more than 65% of the relevant stress periods in GB, the Irish price zone is more expensive than the British one in this update FY2018




Note: If the equivalent of a carbon price floor is decided on one of the foreign price zones, the percentage of tight time the differential would be in favour of GB might decrease to some extent.

# INSIGHT INTO FIRST OPERATIONAL DATA OF NEMO

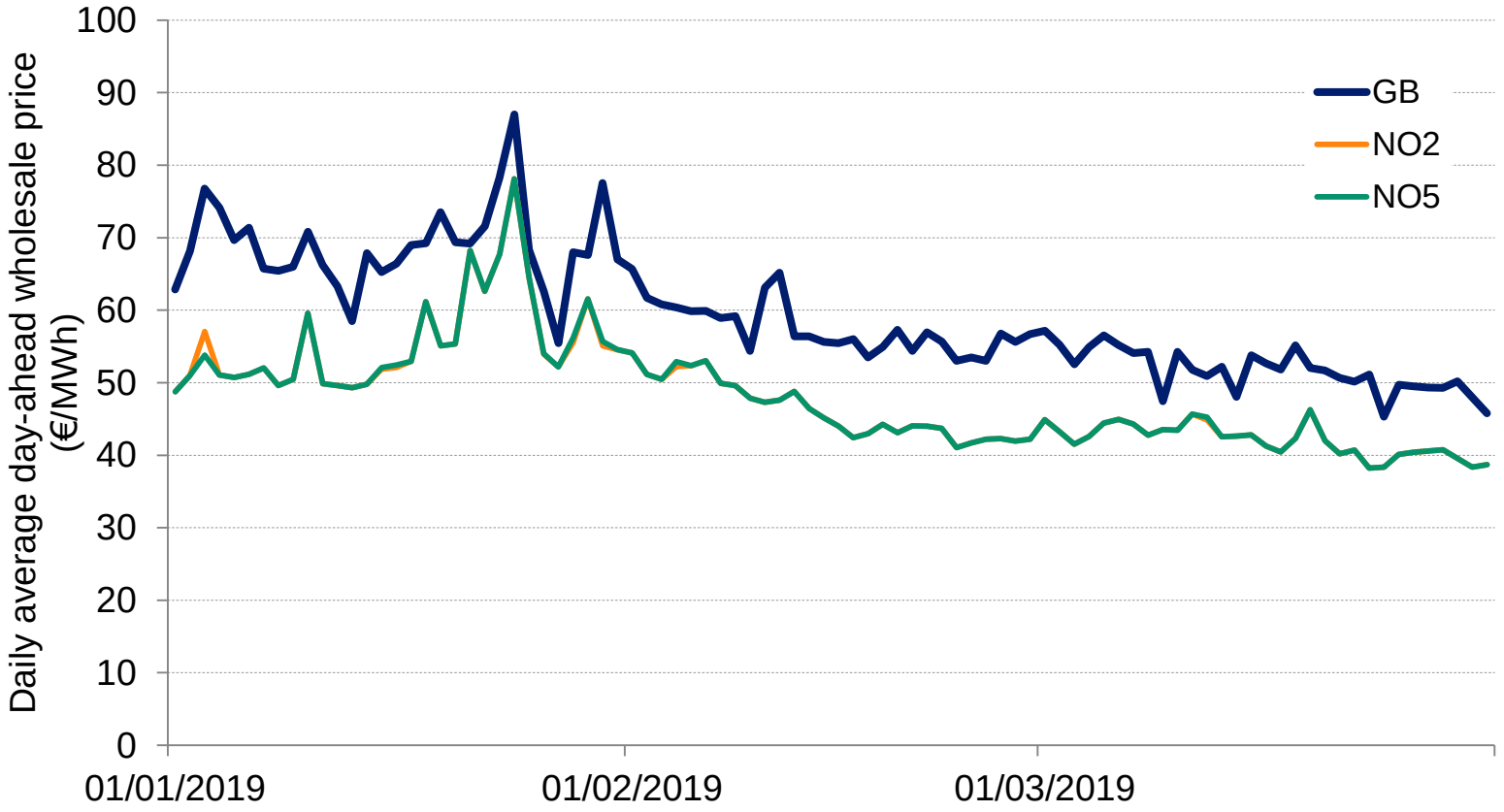
## Looking at every hour in February and March 2019, Nemo flows were efficient




Source: flows were extracted from ENTSO-E transparency platform

# PRICE DIFFERENTIAL GB AND NORWAY

## Price differential between NO2 and NO5 is small compared with the one with GB



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# SUMMARY OF APPLIED APPROACH AND UPDATED DE-RATING FACTORS

| | Relevant periods | Applied metrics | Applied metrics |
|---|---|---|---|
| **Applied approach** | • Highest 50% of GB peak demand periods during winter quarter<br>• Time series of last 7 years | **Existing interconnectors:** Contribution to de-rating factor only when day-ahead price differentials are positive and GB is importing electricity | **New interconnectors:** Contribution to de-rating factor when day-ahead price differentials are positive |

## Historical de-rating factors of existing and new interconnectors

Highest 50% of peak demand periods during winter quarter (7am-7pm business days, Dec 2012-Feb 2019, 2656 total relevant periods)

| DRF calculations based on: | Interconnector between GB and: | | | | | |
|---|---|---|---|---|---|---|
| | France | Ireland | Netherlands | Belgium | Norway (NO2/NO5) | Denmark |
| Price differential (+ve i.e. GB price > price in France) | | | | 68% | 97% | 95% |
| Price differential (+ve) & GB imports | 62% | 8% | 75% | | | |

- In line with the requirements of the Capacity Market (amendments) Rules (2015), interconnectors to Belgium, Norway and Denmark are treated as new interconnectors as they do not yet have seven complete years of operational data. Their de-rating factors are based only on price differentials during the relevant periods.
- The de-rating factors of new interconnectors are before any adjustments for technical reliability and losses. As proposed in the original study and in the 2017 Update, these de-rating factors will need adjustment for technical reliability (including ramping) and a minimum positive price differential threshold to compensate transmission losses.

# KEY FINDINGS

- In general, the historical de-rating factors for interconnectors have increased when based on the latest seven years time series i.e. Dec 2012 – Feb 2019.

| DRF based on: | Interconnector between GB and: | | | | | | |
|---|---|---|---|---|---|---|---|
| | France | Ireland | Netherlands | Belgium[2] | Norway[2] | Denmark[2] | Germany[2] |
| Feb. 2015 Study (time series: **2008-2013**) | 29% | 2% | 62% | 58% | 74% | Not part of the study scope | Not part of the study scope |
| May 2016 Update (time series: **2009-2015**) | 45% | 2% | 70% | 65% | 76% | | |
| April 2017 Update (time series: **2010-2016**) | 48% | 4% | 75% | 65% | 85% | 87% | |
| April 2018 Update (time series: **2011-2017**) | 55% | 5% | 70%[1] | 67% | 96% | 93% | 82% |
| June 2019 Update (time series: **2012-2018**) | 62% | 8% | 75%[1] | 68% | 97% | 95% | Not part of the study scope |

- The increase in de-rating factors is mainly driven by the removal of the low 2011/12 DRFs from the seven-year time series.
- The annual 2018 DRF for Ireland has increased, with a noticeable improvement in the correlation of flows and price differentials between the two markets in the last year with the beginning of I-SEM. The average over the last seven years is still weighted down by pre I-SEM historical data.
- The annual 2018 DRF for France has slightly increased although still weighted down by the market related issues in 2016, which were not related to the efficiencies of the flows.

1 DRF for interconnector to the Netherlands include in the April 2018/2019 Updates both price differentials and flows

2 DRFs for interconnectors to Belgium, Norway, Denmark and Germany are based on price differentials only.

# CONSIDERATIONS FOR UPDATING THE METHODOLOGY

**The following areas for potential revision to the methodology have been identified:**

- Thresholds for price differentials and import (i.e. flow) levels:
  - Should there be a minimum threshold for positive price differentials and/or for import levels in calculating the de-rating factors?
  - What will be the basis for setting minimum thresholds for price differentials and for import level?
- Technical reliability:
  - Are the reliability factors (as proposed in the SKM analysis[1]) reflective of the future availability of interconnectors?
  - How to determine the reliability of new interconnector during the ramping period?
- Future response of interconnector flows to dynamic pricing (e.g. intraday prices):
  - How to capture the inconsistency between the intra-day market and day-ahead market prices in calculating historical DRFs?
- How the de-rating factors should be calculated for new interconnectors to already connected markets (i.e. Ireland, France and the Netherlands)?
  - Should interconnector de-rating factors be asset or market specific?
- Review of the robustness of conservative estimates of historical de-rating factors considering major market or policy developments (e.g. doubling of interconnector capacity to a currently connected market, etc.)

1 Calculating Target Availability figures for HVDC interconnectors, SKM report to Ofgem, December 2012

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