Securely Connected:
The contribution of electricity interconnectors to GB security of supply

A report on behalf of National Grid Ventures

Interconnectors are high voltage transmission cables that allow electricity to flow between electricity markets. They bring many benefits to GB consumers, including allowing imports of lower-cost electricity into the GB market (thereby reducing consumer prices) and supporting the decarbonisation agenda. They also contribute greatly to GB security of supply by enabling the import of electricity at times of so-called 'system stress', when GB might have insufficient generation available to meet the country's needs. However, in the 'Capacity Market' which rewards providers for being available at times of system stress, the contribution of interconnectors is under-estimated and under-compensated.

Key takeaways

- *Interconnectors are highly likely to import when needed, based on analysis of market dynamics*
- *The current 'de-rating' factor methodology is flawed and underestimates this likelihood*
- *This increases costs for consumers*
- *The Capacity Market review is an opportunity to explore ways in which interconnector de-rating factors can be better aligned with the best interest of consumers*

Interconnectors play a key role in reducing consumer costs of security of supply

The contribution of interconnectors to GB security of supply is reflected in the participation of interconnectors in the 'Capacity Market'. In return for compensation, capacity providers have an obligation to be available to provide electricity should the operator of the electricity system announce that it has system stress concerns.

The operation of the Capacity Market involves a metric known as a de-rating factor which, broadly speaking, reflects the probable availability of each generator class or interconnector at times of system stress. For an interconnector, the probability of it importing electricity to GB at times of high GB system stress is driven predominantly by the market dynamics between GB and the connected country. However, the de-rating factor estimates need to be finely balanced since overestimates increase the chances of system stress, whereas underestimates means additional capacity will be procured in the Capacity Market unnecessarily – with the cost falling wholly upon consumers.

For interconnectors, the cost factor is especially relevant – since interconnectors are among the lowest-cost participants in the Capacity Market. If, say, 1GW* of interconnector capacity was taken out from the most recent four-year ahead auction we estimate that the clearing price would have been about £10/kW rather than £8.40/kW, costing consumers over £80 million.

*Approximately 6.5 GW of physical interconnector capacity qualified for last year's T-4 auction (delivery year 2021/22). The application of de-rating factors reduced the interconnector capacity able to participate in the auction to 4.6 GW, a reduction of 1.9 GW.

> *Reducing interconnector capacity in the most recent auction by a further 1GW would have cost consumers over £80 million*

Analysis of actual market conditions suggest interconnectors are highly likely to be able to contribute when needed

We looked at how the de-rating factors could be estimated, using 'price' and 'margin' as our key proxies of system stress and analysing the historical coincidence of system stress between GB and connected countries (Ireland, France, Netherlands) or potentially connected countries (Belgium, Norway, Germany, Denmark). This is on the basis that electricity will flow from countries with lower stress to those with higher stress at a given moment.

Methodology

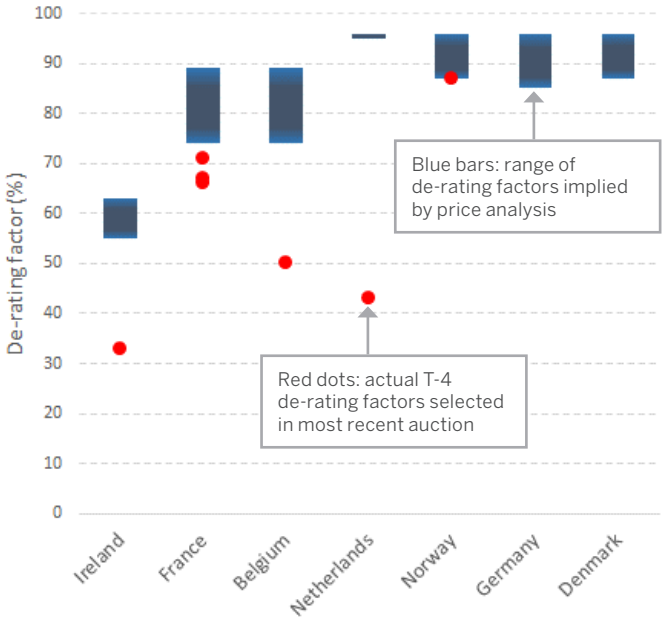
The two key metrics used to proxy for system stress were:

Prices. We assumed that 'high' prices in GB are indicative of a relatively tight GB system and one that is close to system stress. We then assessed, **at those times of high GB prices**, how frequently the price in the neighbouring country was even higher – therefore indicating that the neighbouring country would be unlikely to export to GB at that time.

Margins (which is a measure of the excess of generation capacity relative to a country's demand at a given point in time). We assessed those occasions when there was **relatively little spare available generation capacity relative to demand in GB** and considered whether there was sufficient spare capacity in neighbouring markets at those times to be able to supply electricity across interconnectors.

Analyses were conducted over a range of periods but focused on times of near system stress in GB, which is more relevant than the unfocused analysis currently conducted.

Our results show that when the GB electricity market has been most stressed (i.e., **in conditions that are most relevant to GB security of supply**), the market conditions that drive interconnector flows are almost always such that flows to GB would be expected. The figure below shows implied de-rating factors based on price analysis (making the conservative assumption that technical availability issues would further reduce the probability by 4% for each country).



As the figure above shows, the probability of interconnectors being available for imports to GB would be 75-95% during relevant periods for the countries we have looked at (other than for Ireland, which is a special case).

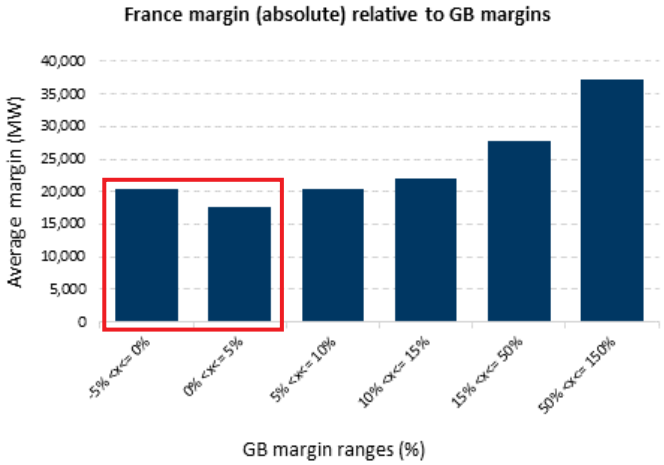
Therefore, when needed most, our analysis of history shows that interconnectors can be relied upon to deliver.

> *Historically interconnectors would be available 75-95% of the time for the currently connected or due to be connected countries*

The evidence also suggests that the current levels of de-rating factors, as also indicated in figure above, might be unduly conservative (resulting in higher than necessary costs for consumers).

Some stakeholders have argued that as more interconnectors are developed between GB and the connected countries, the additional interconnector capacity becomes redundant as the interconnectors are tapping into a 'limited' pool of spare capacity.

However, there is typically a significant amount of 'spare capacity' (i.e., margin) in other countries, even at times of GB system stress – e.g. in France, as shown below, there is on average over 15GW of margin (under our definition) during periods of very low GB margins.



Note: 'margin' calculated by reference to ENTSO-E data sets: installed capacity less outages less demand.

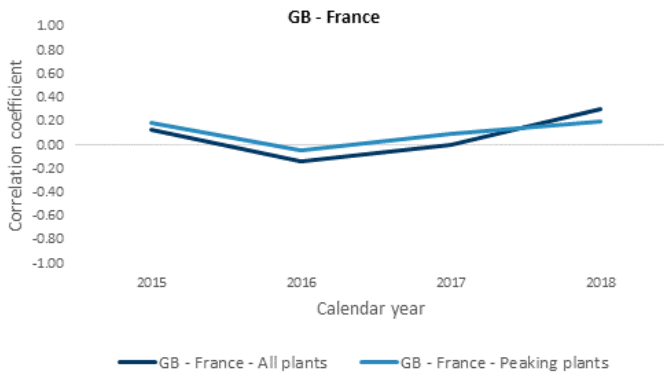
Some commentators have also expressed a concern that using historical data to set the de-rating factor would not reflect changes in the generation mix in neighbouring countries that are likely to occur over the four-year period between the time the factor is set and the time the capacity must be available. In short, commentators argue that historical trends might not be reflective of the future. Whilst there are likely to be some changes, in our view the differences are not likely to be so great that the historical patterns are irrelevant (we return to this later below).

Supply-side indicators

High levels of generator outages drive stress, and some have argued that in the future, low levels of wind may drive stress (as the system becomes more reliant on wind power).

We have, therefore, considered the correlation between GB and other countries for supply-side indicators such as wind generation and generator outages.

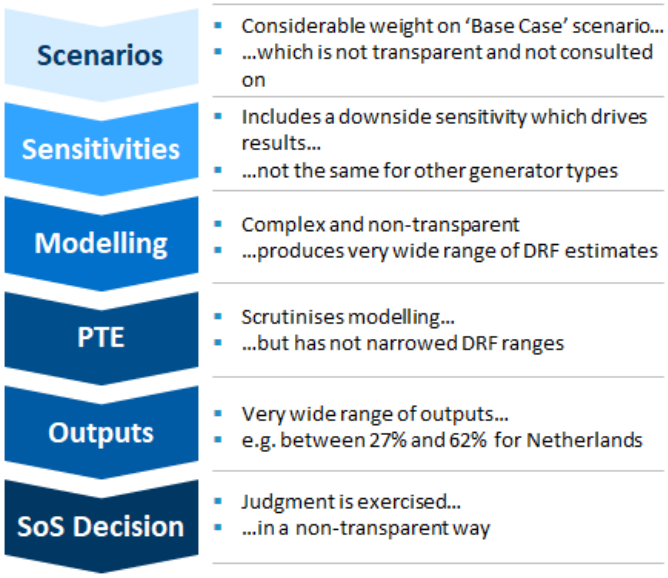
Generator outages: there is not a high correlation of forced generator outages between GB and each connected country. This indicates that it is not likely that system stress could arise simultaneously in both GB and each connected country due to generator outages. This protects the valuable contribution of interconnectors to GB security of supply in times of stress. For example, between GB and France:



Wind: there is not a high correlation of low wind generation between GB and each connected country. This indicates that it is not likely that system stress could arise simultaneously in both GB and each connected country due to low wind availability. Again, this protects the valuable contribution of interconnectors to GB security of supply in times of stress.

The current method for estimating interconnectors' contribution is flawed and overly conservative

We have also conducted a review of the current methodology for selecting de-rating factors. Broadly speaking, an extremely complex modelling methodology is used, which draws on a large range of input scenarios, to result in a very large range of de-rating factors for each interconnector, which informs a decision ultimately made by the Secretary of State ("SoS") with the guidance of a panel of technical experts ("PTE"). The figure below summarises the key criticisms we have of the current process.



Ultimately this means that, despite the considerable technical complexity of the modelling process, the de-rating factor choice is to a large extent subjective.

For these reasons alone, we would conclude there are grounds for re-considering the interconnector de-rating factor methodology.

There are also reasons to believe that the current interconnector method may result in de-rating factors that are **biased downwards**:

- The (non-transparent) 'Base Case' scenario drives a lot of the lower modelling output results. Placing greater emphasis on the (consulted upon) Future Energy Scenarios ("FES") would, all else equal, likely result in higher de-rating factors for interconnectors, resulting in considerable savings for GB consumers.
- The use of a single 'downside' sensitivity has a large influence on the results. Providing a more balanced sensitivity analysis would likely result in higher de-rating factors for interconnectors, resulting in considerable savings for GB consumers.

Overall, our view is that the current method of selecting de-rating factors is therefore overly conservative, resulting in de-rating factors that are considerably below what the historical analysis would imply. There are merits to placing greater weight on (less subjective) historical analysis, if that historical analysis properly reflects periods of high system stress in GB (i.e., by examining periods of high prices or low margins in GB, as per our methodology described above, rather than solely looking at periods of higher-than-usual demand).

> *"The current method is overly conservative, resulting in de-rating factors that are significantly below what the historical analysis would imply"*

Alternative options for assessing security of supply

Given that Britain has not experienced a system wide scarcity event for several decades, it is inevitable that an assessment of how interconnectors would perform under such an event will be challenging. The 'perfect' de-rating factor methodology is unlikely to exist, as there are always trade-offs (for example, a fully prescriptive approach reduces scope for subjectivity, but is less flexible). The 5-year Capacity Market review (and subsequent consultation, which is relevant to the same substantial issues) is an opportunity to explore ways in which de-rating factors can be better aligned with the best interests of consumers.

For example, one approach could be to use an appropriate historical analysis such as that described above (i.e. properly reflecting periods of high system stress in GB) but then adjust the factor by a fixed amount. This reduction would reflect the inherent uncertainties regarding the future (and, in particular, the risk that a neighbouring country has a significant change in generation fleet over the four-year period) and could be set in a way that reflects the degree of a caution and conservativeness that policy makers wish to apply. Whilst perhaps arbitrary, it is likely to be less arbitrary than the current modelling approach. It does however, have the advantage of being transparent in the inherent trade-off between cost and cautiousness: e.g., a higher factor would reflect a more cautious, but more costly, approach.

Alternatively, a more radical approach would see the design of the Capacity Market altered. If policy makers determine that the penalty regime of the Capacity Market should be strengthened, this could potentially provide appropriate incentives for eligible participants (i.e. interconnectors and all generator classes) to select their own de-rating factor. With a revised penalty regime and secondary trading rules, this approach moves the risk-setting role from policy-makers to the participants (who are arguably best placed to understand and manage the risk).