Future of Interconnectors Executive Summary

A report to ESO

MAY 2023

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1 About the project

Future of Interconnectors is a Network Innovation Allowance (NIA) funded innovation project started in 2022 by ESO with consultants AFRY, focused on analysing the opportunities and challenges that an increase in interconnection presents to the ESO as we move towards a net zero electricity system.

Aims of the project are to understand:

a) how interconnectors (IC) contribute to the different dimensions of system operation (adequacy, flexibility, and operability);
b) how their behaviour and impact may evolve as we transition to a net-zero system; and
c) what challenges/barriers may limit the system's ability to extract value from interconnectors and how these can be removed/mitigated.

The project uses both qualitative and quantitative analysis to achieve these aims, including:

1. quantitative review of historical interconnector performance;
2. extensive stakeholder engagement across ESO and the interconnector community;
3. market simulation modelling of ESO's 2022 Future Energy Scenarios and their corresponding European scenarios to illustrate the shifts in interconnector operation in the period 2025 to 2035; and
4. qualitative assessment of potential market, regulatory and policy initiatives to identify key opportunities and risks of a system with a larger share of interconnectors

In addition, the project considers the robustness of the observations/recommendations in light of live market issues such as the Review of Electricity Market Arrangements (REMA) process and emergence of new business models such as Multi-Purpose Interconnectors (MPIs)[1].

1. In the context of this project, the term Multi-Purpose Interconnectors (MPIs) covers also Non-Standard Interconnectors (NSIs)

Four main reports (‘Status Quo’; ‘Future Landscape of Interconnectors’; ‘Future Role of Interconnectors’ and ‘Long-list of Options’) have been produced as a result of this project, which collectively will inform final recommendations and establish a solid foundation for future decision-making in this crucial area of energy policy.

This Executive Summary outlines the analysis conducted and key findings of the project in the different areas that have been explored.

2 Status quo

At the time of writing, Great Britain (GB) has 8 operating interconnectors (8.4GW) and 5 additional interconnectors approved under Ofgem's cap and floor regime (7.5GW)[2].

Historically, GB has been a net importer of power.

Interconnectors are flexible assets that respond efficiently to price differentials across various timeframes. However, the UK exit from the EU led to the de-coupling of GB from European electricity markets, resulting in under-utilisation of interconnectors and increased complexity for market participants and system operators. Other market coupling initiatives were also blocked, i.e. Single Intraday Coupling (SIDC) and access to the common EU reserve markets, preventing efficient trading in the intraday timeframe and making the path to find effective solutions for exchange of balancing reserves more challenging.

For cross border trading in the day-ahead and intraday timeframe, several different temporary trading solutions have been implemented since leaving Single Day-Ahead Coupling (SDAC), most explicit and some implicit:

2. At the time of writing, the results of Cap and Floor Window 3 hadn’t been published.

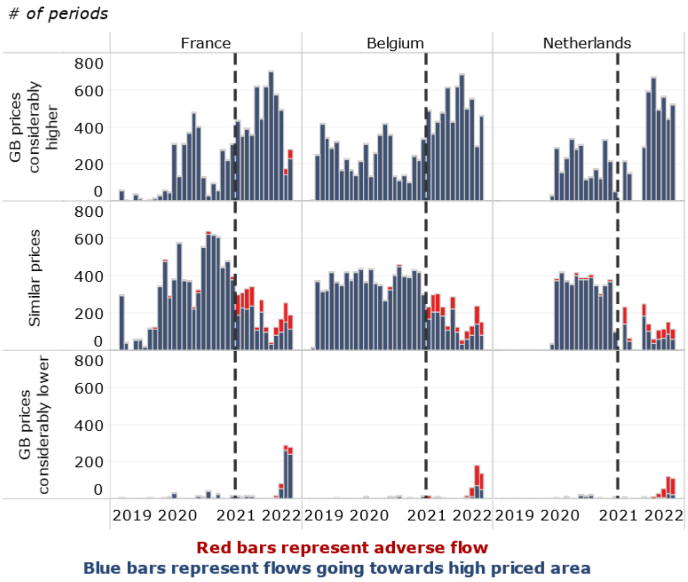
Exhibit 2.1 – GB IC overview, short-term markets

	Explicit		Implicit	
	Day-Ahead Capacity Auction	Intraday Capacity Auctions	Day-Ahead Auction	Intraday Auctions
Moyle & EWIC	☒	☒	☒	☑
BritNed	☑	☑	☒	☒
IFA & IFA2	☑	☑	☒	☒
Nemo Link	☑	☑	☒	☒
ElecLink	☑	☑	☒	☒
NSL	☒	☒	☑	☒

Notes: This exhibit reflects the GB interconnector overview at the time of writing, before the commissioning of new interconnectors such as Viking

Current arrangements are not harmonised with EU markets and can lead to inefficiencies in operation that can have adverse consequences. For example, periods with adverse flows have increased since leaving SDAC and are expected to remain inefficient in the absence of market coupling arrangements. This is especially true for the interconnectors with explicit auctions, shown in exhibit 2.2 below.

Exhibit 2.2 – Periods per month with adverse flow at day-ahead stage, before and after Brexit



Notes: The vertical dashed line shows when market decoupling happened
Source: Day-ahead scheduled (nominated) flows and prices from ENTSO-E. Day-ahead prices in GB post 2021 from N2EX

Currently, interconnectors' direct participation in standard GB balancing markets is limited, and they are not eligible to participate in the Balancing Mechanism (BM). However, the ESO has mechanisms in place to utilise interconnector capabilities for system security purposes, including capacity restriction, ESO trades, SO-SO services, and emergency services. It is worth noting that some of these measures are at times needed due to challenges posed by the interconnectors themselves. The expenditure on interconnectors for balancing purposes is substantial. The cost of ESO trades alone exceeded one billion pounds in 2022, where thermal constraints and margins represented 35% and 43% of the volume traded respectively[3].

In respect of adequacy, interconnectors were awarded in total ~26GW in the CM T-4 auctions for delivery 2023-26, representing ~16% of total awarded contracts. This accounted for a total of £853m, i.e. on average £213m per year.

The de-rating factor varies for each interconnector and remains a topic of discussion. In some instances, current arrangements might limit the potential response to changing adequacy needs in different timeframes. It is also possible that GB exports power in tight periods.

The status quo highlights a series of the emerging challenges that could escalate in the future if not addressed efficiently. This is largely due to growing adequacy and operability concerns and increasing need for flexibility, while at the same time GB interconnection is expected to continue to increase.

3 Future role of interconnectors

3.1 Interconnection and the energy landscape

The future landscape of GB's energy system indicates that interdependencies between GB and neighbouring markets are likely to increase. According to FES 2022, by 2035 projected interconnection capacity is expected to reach 13-25GW, compared to 8.4GW at the time of writing.

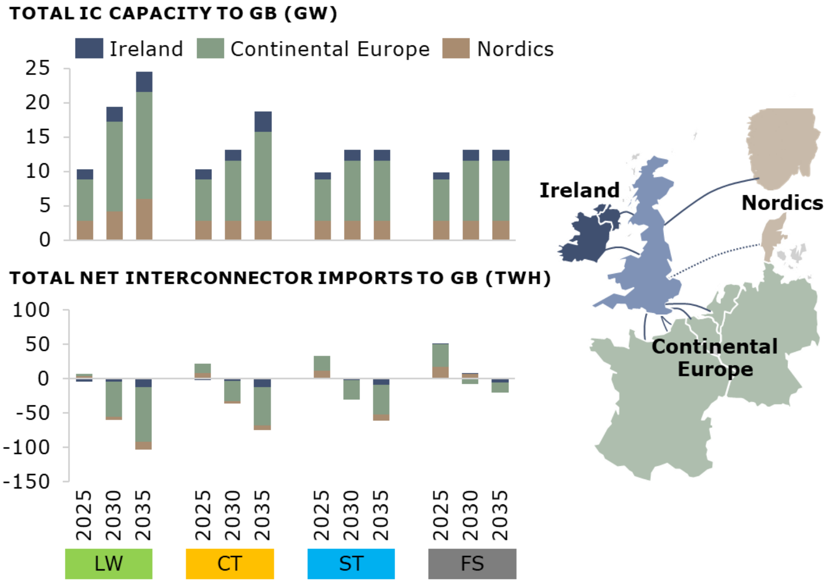
GB and connected regions will see significant changes in their energy mix towards net zero. This will in turn impact the interconnector flows across the regions.

- By 2035, GB's renewable energy sources (RES) share of generation is expected to grow to around 80%, with unabated thermal share dropping to ~5% and abated thermal rising to about 15% due to nuclear, hydrogen-fired, and carbon capture and storage (CCS) new builds (based on the median values across all FES 2022 scenarios). Carbon intensity is projected to decrease across all scenarios.

3. For reference, the total cost of balancing the system in 2022 was approximately £3bn (Source: ESO). It is worth noting that 2022 was an exceptional year due to the impact of the gas crisis.

- In contrast, Ireland maintains a higher carbon intensity due to a higher share of unabated thermal generation and no CCS biomass deployment, and is expected to become a net importer by 2035 across all scenarios.
- The Nordics are expected to develop an even cleaner energy mix by 2035, but become net importers from GB.
- Continental Europe's carbon intensity is expected to decrease by 2035 due to higher RES penetration and cleaner thermal generation, but GB's faster decarbonisation will result in a shift, with GB becoming a net exporter.

Exhibit 3.1 – Overview of forecasted IC capacity and net flows by region



In a net-zero scenario, interconnectors' influence expands, offering potential optimisation of socio-economic welfare (SEW) and improved system security, but may intensify certain issues if mismanaged. The project has explored opportunities and challenges related to the key dimensions highlighted by ESO, i.e. Adequacy, Flexibility and Operability:

- **Adequacy**: As interconnection increases, opportunity to share capacity, i.e. firm power, increases. If not managed properly, a competition for the same resources could arise between connected countries.
- **Flexibility**: Interconnectors are inherently flexible assets. To achieve maximum socio-economic benefits, efficient trading arrangements are required, unlocking other flexible providers in regions where it is most economically viable.
- **Operability**: Given their significant size and concentration in particular regions, interconnectors can exacerbate system challenges. However, with effective and well-structured arrangements, these challenges can be mitigated, leading to overall system cost savings. Additionally, interconnectors can play a more significant role, contributing positively to system operability beyond merely

counteracting their own negative impacts. Efficient scheduling of cross-border flows in the market is a crucial factor.

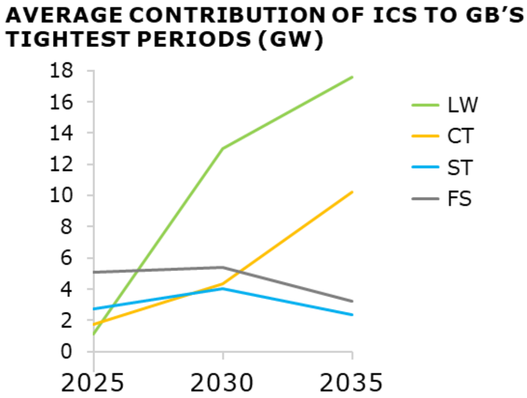
3.2 Modelling results

Our modelling has highlighted some interesting changes in the role/impact interconnectors may have on GB's energy system by 2035:

Adequacy

– Increased contribution to security during periods of system stress in scenarios with high interconnection and variable RES (Leading the Way (LW) & Consumer Transformation (CT)), as shown in exhibit 3.2

Exhibit 3.2 – Forecasted IC contribution during GB system stress



Notes: LW=Leading the Way, CT=Consumer Transformation, ST=System Transformation, FS=Falling Short. Tightest periods are here defined as the 100 hours with highest demand across all weather patterns modelled.

– Significant reduction in periods of coincidental stress events between GB and connected countries due to increasing penetration of intermittent RES, as shown in exhibit 3.3

Exhibit 3.3 – Share of time that an interconnected country is at the same level of stress at the same time as GB (%), 2035 compared with historical 2015 values.

	2015	2035 LW	2035 CT	2035 ST	2035 FS
Belgium	37%	5%	6%	16%	20%
France	33%	6%	7%	9%	15%
Germany	31%	1%	5%	9%	15%
Netherlands	22%	3%	6%	25%	34%
Denmark	35%	1%	5%	10%	15%
Norway	15%	4%	6%	11%	15%
Ireland	44%	6%	12%	20%	33%

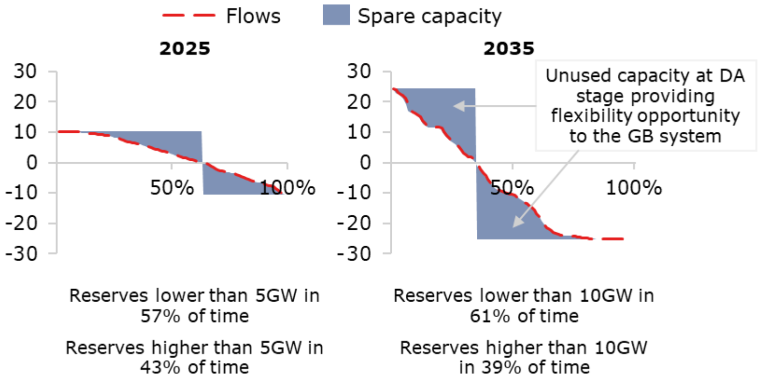
Notes: The data shown here considers all the 5 weather years evaluated. Here, GB's tightest hours are defined as the highest 1% peak periods. 2015 is used for the comparison with 2035 as renewable penetration was low.

- Longer duration of peak demand periods, from 8-13 hours in 2025 to 11-28 hours in 2035, increasing the potential reliance on interconnectors

Flexibility

- Change in direction of flow during a day is forecasted to remain highly dynamic, adapting to volatile price signals
- Increased interconnector capacity extends the role of interconnectors to provide flexibility at different timeframes, indirectly replacing some of the conventional dispatchable sources
- Increasing spare capacity after day-ahead (DA) stage in scenarios with high degree of interconnection, will provide greater flexibility potential to the system intraday, illustrated in exhibit 3.4

Exhibit 3.4 – IC utilisation and flexibility provision (GW)



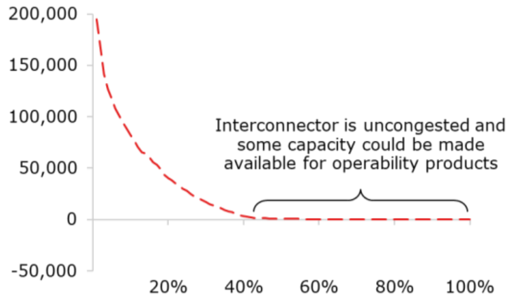
Notes: The chart only highlights flexibility in the same direction as the flows. However, due to reverse flows, interconnectors can provide flexibility in both directions. Data shown is for the LW scenario for illustrative purposes only. The terms 'spare capacity' and 'reserves' are used interchangeably in this context.

Operability

- Scenarios with more interconnectors and RES capacity show greater need for re-scheduling of interconnectors, with the main driver being transmission constraints

- With more congestion, interconnector landing points become increasingly important. Sensitivity modelling, involving the relocation of one interconnector from the south of the LE1 boundary to the north of the boundary, indicates potential cost savings by 2035. Specifically, the model shows potential savings of EUR 13-17 million in ST and LW scenarios, respectively
- Interconnectors are forecasted to be uncongested roughly 60% of the time in all modelled years and scenarios, meaning there is room for utilising the interconnector for balancing purposes during these times, ref. exhibit 3.5

Exhibit 3.5 – Duration curve of the congestion rent of an IC (€)



Notes: The behaviour displayed in the duration curve represents the general trend seen across all interconnectors in all modelled years and scenarios.

- Interconnector flows can be adjusted through trades to alleviate grid congestion. CT scenario indicates a potential accommodation of 36TWh annually in 2035, allowing reducing the need for variable RES curtailment
- Modelling of future expenditure on ancillary services suggests that enabling interconnectors to provide reserve, response, and inertia services could yield cost savings. The LW projections for 2035 show the most potential impact from allowing interconnectors to offer these services
  - It is however important to note that costs will be incurred at the other end of the cable, which have not been factored in. Nevertheless, these costs are anticipated to be lower than the domestic savings. Also, the cost associated with investment/retrofitting interconnectors with grid forming technology for inertia provision is not accounted for.

3.3 Opportunities and challenges for consideration

As it stands, to achieve the best value for the system from interconnectors, we will need to address current challenges/gaps related to market signals/operation and regulatory frameworks that may lead to under or over-reliance on interconnectors and therefore higher costs to the system and consumers in the energy transition.

While we see potential improvements in the contribution of interconnectors, discussions with interconnector developers and our own review of the commercial, policy and regulatory environment have highlighted a range of interconnected challenges in realising this outcome.

Policy and regulation: Policy & regulatory alignment (or misalignment) between GB and connected markets can severely influence interconnector behaviour in both planning and operational timescales.

- *TSO interaction and relationships:* Emergency actions between TSOs are sometimes required to ensure system security. How to understand, quantify the benefits and agree costs for actions with other TSOs is key. At present there are a wide range of bespoke arrangements.
- *Political challenges*: Interconnectors change the distribution of benefits & costs between producers/consumers in different connected markets which can be unpopular amongst parties that are perceived to 'lose out' from changes to arrangements or deployment of interconnectors.
- *Regulatory incompatibility*: While regulatory change aims at enabling and incentivising initiatives based on evolving domestic politics, incompatible regulations between connected countries can be detrimental to interconnector efficiency.

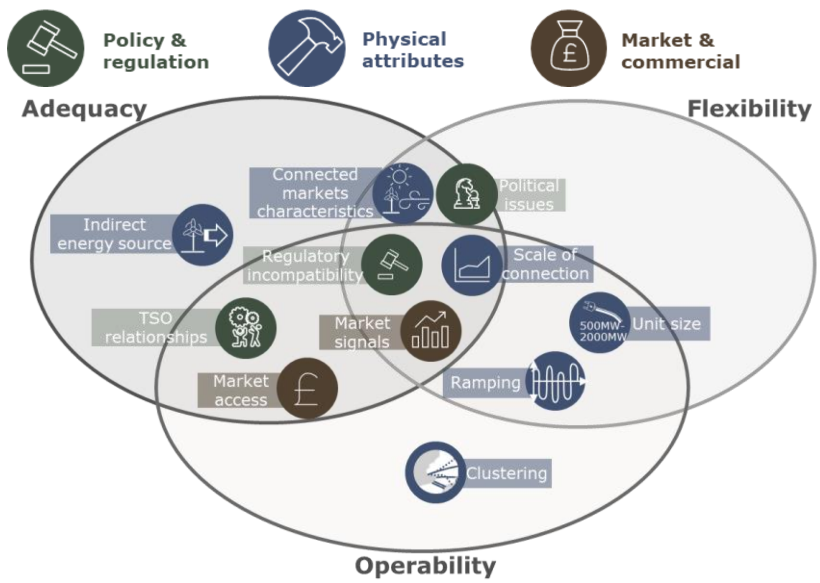
Physical attributes and characteristics: Interconnectors' physical characteristics have the potential to alleviate grid issues in GB, yet they may also exacerbate certain challenges.

- *Interconnector capacity size (unit size)*: Each individual interconnector is of a considerable size and has a notable potential physical impact on GB's electricity market and system, as well as system security requirements (system contingencies/largest loss).
- *Aggregated interconnector capacity*: With increasing interconnector capacity, the aggregated effect of interconnectors is considerable. Interconnectors can support GB's transition towards net zero. However, collective scale amplifies all challenges related to interconnection.
- *Physical characteristics of connected markets*: The physical systems of connected markets will have an impact on interconnector operation. Sharing of renewable resources and capacity may offer opportunities due to imperfect correlations in demand and weather patterns, but resource adequacy in critical periods can be a challenge.
- *Location of GB landing points*: Clustering is strongly driven by geographical factors, and the location of landing points has an impact on the grid and other grid users. Clustering of interconnectors can have a considerable effect on congestion, stability, and voltage in the area.
- *Ramping*: Whilst interconnectors are a highly flexible energy resource, the ability for the system to accommodate rapid changes in flow position is governed by system security constraints. This can limit the potential flexibility of interconnectors.
- *Indirect energy source*: Interconnectors do not generate active power themselves, instead they provide access to third party energy resources. This means they are not tied or limited to a specific fuel or energy source, but their operation depends on the availability and relative economic efficiency of collective energy resources in connected markets.

Market and commercial: Appropriate market mechanisms must exist to maximise socio-economic welfare (SEW).

- *Market signals*: As commercial assets, flows are generally determined by price signals, which should be designed to efficiently distribute SEW. This requires an efficient market, both long-term and short-term. Weak or distorted signals can risk leaving economic value on the table. Lack of locational signals can also exacerbate constraints as interconnector scheduling does not account for internal transmission limitations.
- *Market access*: To incentivise the contribution of interconnectors, it is important to establish access to markets that reward their contribution to the system in an efficient way. Each country should share the cost and benefits to ensure that the value of the interconnector is fairly distributed.

The Venn diagram below provides a visual representation of the impact of different interconnector challenges relative to the dimensions identified by ESO (Adequacy, Flexibility & Operability). It should be noted that the diagram is not meant to be a precise or exhaustive representation, and many solutions to these issues will likely have cascading effects.



4 Emerging Changes

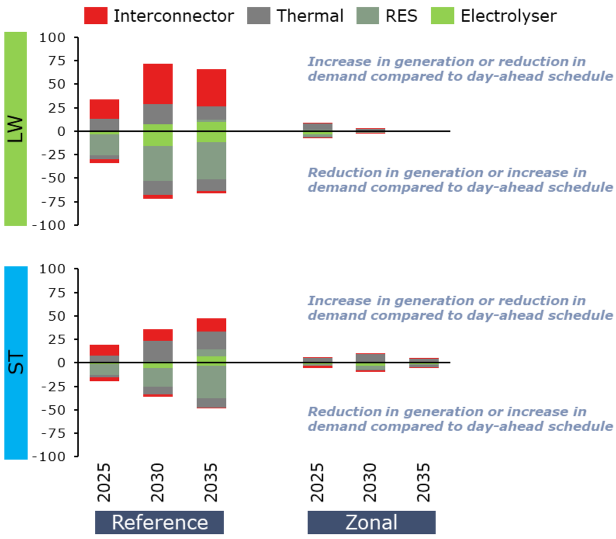
The opportunities for the system from interconnectors and the challenges faced may be affected by ongoing developments in the market, two of which are locational pricing as a part of REMA and the introduction of MPIs.

4.1 Zonal markets

The project included modelling of interconnector flows under the implementation of a simplified zonal market in GB of 4 zones. The modelling shows that the main conclusions around adequacy, flexibility and operability are not significantly affected by the introduction of locational pricing. However, a zonal system presents unique considerations for interconnector utilisation, congestion rent, and development incentives.

- Reduced redispatch volumes, as grid constraints are more or less accounted for in market scheduling depending on the solution. The zonal sensitivity analysis (exhibit 4.1) indicates that implementing a zonal market can reduce balancing actions and redispatch volumes, leading to material savings from reduced balancing mechanism actions. Further analysis is needed to assess the full system impact of more granular arrangements (more or less zones), to assess the extent of efficiency savings that could be derived from zonal pricing and to consider the increased significance of other boundaries that haven't been modelled.

Exhibit 4.1 – Total redispatch volumes (TWh), single price market vs. zonal market.



Notes: Results are shown for the 2016 weather patterns.

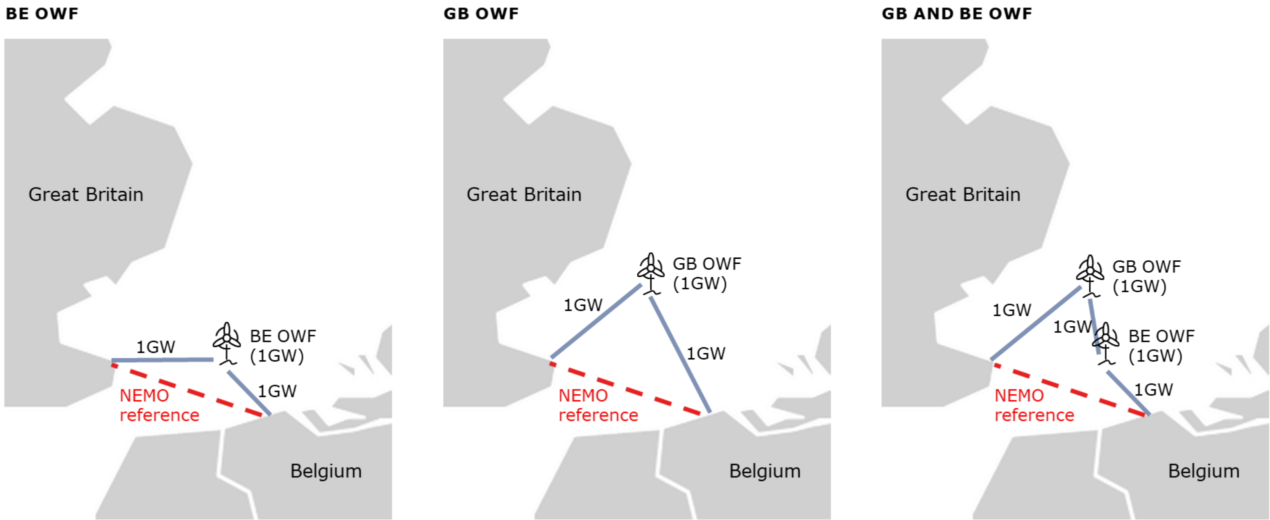
- Interconnector utilisation can be impacted by zone characteristics and connected markets, with price differentials and transmission constraints playing significant roles.
- Zonal markets lead to price variations between zones, affecting congestion income and interconnector project viability.
- A zonal market incentivises the development of new power sources in areas with higher prices and development of power intensive industry in areas with lower prices. The same mechanisms would drive for more connections between low and high price areas.
- Transmission constraints may limit interconnector utilisation in highly congested zones.

4.2 Multi-Purpose Interconnectors (MPIs)

While the framework for MPIs is still under development, the purpose of this sensitivity was to study different MPI configurations and their potential future impact on flows. The analysis compares a reference scenario, the NEMO Interconnector, to alternatives where NEMO is replaced with an MPI, connected to either one or two 1GW offshore wind farms (OWF). Route lengths for MPIs differ based on the location of connecting OWFs, resulting in varying transmission losses across cases. MPIs were compared under 'Home Market' and 'Offshore Bidding Zone' market set-ups.

The results of this sensitivity provided data on the frequency of maximum and zero flows and offered insights into the potential contribution of MPIs to adequacy, flexibility and operability.

Exhibit 4.2 – Overview of the scenarios analysed



Notes: 'OWF' stands for Offshore Wind Farm.

Key findings from the analysis include:

- Regarding adequacy, flows in MPI cases are still driven by relative price differentials and remain at maximum towards the higher-priced market during the largest price differentials. However, the frequency of maximum flows is either the same or slightly reduced with MPIs.
- Flexibility and operability are affected by increased transmission losses due to slightly longer routes of the MPI cases tested when compared to the reference NEMO. This widens the deadband in which price differences are insufficient to trigger market-to-market flows, potentially altering access to flexibility from the connected market when price differentials are low.

- Additionally, the impact of connected wind means that MPI flows are rarely zero, and there is an increased frequency of partial flows compared to conventional interconnectors.
- Considering the relative capacities of the OWF and transmission capacity, the BE and GB OWF MPI sometimes direct flows towards GB, even when it presents a lower-priced market. This scenario typically unfolds when the MPI's capacity to BE has been fully used, and there is surplus wind output seeking a route to market. Such a situation could potentially carry implications for the operation of the onshore system.

5 Options for addressing future challenges

The long-list of options developed as part of the project presents an array of solutions designed to tackle identified challenges. These options have been collaboratively developed with ESO to offer a range of possibilities for further evaluation. Other solutions might exist that have not been identified or considered.

5.1 Challenges identified

Twelve opportunities for development, categorized under adequacy, flexibility, and operability, were firstly identified collectively with ESO:

Adequacy:

1. Limited co-ordination with neighbouring SOs in long-term planning phase
2. Absence of coordinated interconnector development framework
3. Uncertain contribution in GB stress event
4. Uncertain behaviour of interconnectors in mutual stress events

Flexibility:

5. Non-harmonised day-ahead market designs
6. Inefficient intraday market arrangements
7. Onshore system constraints limit interconnectors’ ramping potential

Operability:

8. Inability to fully utilize interconnectors’ capabilities for real-time response
9. Inability to access available reserves in neighbouring countries in the balancing timeframe
10. Planning of interconnector projects does not properly reflect operational needs
11. Scheduling of interconnector flows does not account for system constraints in an efficient way

12. Bespoke interconnector trilateral arrangements are inconsistent causing operational complexity

5.2 Potential solutions

The long-list of options presented on pages 20 & 21 identifies several alternatives for addressing the challenges above and to achieve a more optimised use of GB interconnectors. The report aims to guide the efforts of stakeholders, including the ESO, to optimise interconnector utilisation for the benefit of consumers, producers, interconnector developers, and TSOs alike. Alignment with the initiatives triggered by the Trade and Cooperation Agreement (TCA) between GB and the EU, is important for addressing these issues effectively.

The potential solutions are listed in no particular order. The complexity of the proposed options varies significantly and time to implementation differs, but this has not been assessed at this stage. Some remarks are listed below:

- **Regulatory barriers**: regulatory barriers hinder certain options, particularly market coupling with the EU. Overcoming these barriers through appropriate channels could yield significant value and resolve numerous issues. Swift resolution leads to greater cost savings.
- **Technical challenges:** Solving technically challenging options may offer substantial benefits. Resources should be invested in overcoming technical barriers or challenges. The value of solving many of these issues increases as GB transitions towards a net-zero system.
- **Operational complexity:** Operational complexity complicates some options, especially those involving TSO cooperation. Closer collaboration to identify more harmonised solutions can generate long-term value.
- **Cascading effects:** Many solutions will produce cascading effects on other issues, potentially offering greater overall value. Prioritisation should reflect this.
- **Time-sensitive:** Some issues are more time-sensitive, especially those related to operational matters, as evidenced during winter 2022/23. Other issues, though not system-critical, negatively impact SEW. Delaying resolution could lead to excessive costs for GB taxpayers.

5.3 Next steps

Step 1 - Long-list of options

This identification of a long-list of options represents the initial step in creating a comprehensive strategy for implementing effective measures to enhance the use of interconnectors, thereby optimising their contribution towards a successful transition to net-zero emissions. The subsequent steps will involve:

Step 2 – Prioritisation

A prioritisation exercise of key issues will be conducted, to ensure resources are initially allocated to the areas that require strategic focus.

This will be followed by the development, verification and evaluation of the solutions associated to these issues, drawing upon ESO's internal assessment and expertise and feedback from the broader industry.

Step 3 – Short-listing and recommendations

This consultation and evaluation process should provide the necessary inputs to conduct a short-listing of solutions and provide recommendations.

Recommendations ought to inform various decision-making processes, which could be led by ESO, the government, or regulatory bodies.

Dimension	#	Opportunity	Description	Options
Adequacy	1	Limited co-ordination with neighbouring SO in planning phase	PLANNING: The absence of cooperation and transparency in adequacy processes between GB and connected countries may result in misaligned expectations of interconnector flows and potentially lead to adverse or inefficient long-term capacity measures for GB and the connected region as a whole.	(A) Adapt current approach to fully reflect EU framework (B) Increase harmonisation with EU methodology (C) Agree treatment of ICs in adequacy assessment in advance with peers
	2	Absence of coordinated IC development framework	DEVELOPMENT: Interconnector projects are considered in adequacy assessments, and delays to and/or lengthy development can result in the need for additional temporary measures to compensate for the missing capacity, leading to increased costs for consumers and development costs.	(A) Bilateral (or multilateral) development planning, with project auctioning (B) Development led - Trilateral (or multilateral) coordinated development (C) Incremental improvement to current individual process
	3	Uncertain contribution in GB stress event	OPERATION: Under normal operation, price signals may not reflect the value of capacity in a given market, or arrangements might limit the potential response to changing adequacy needs in different timeframes.	(A) Aligned incentives of ICs and IC users (B) Improvement of trading opportunities closer to real time (C) ICs excluded from CM. Reliable capacity set as prerequisite. (D) Reliability option for ICs (E) Incremental improvement to current CM process
	4	Uncertain behaviour of IC in mutual stress events	COOPERATION: In certain circumstances neighbouring markets may suffer coinciding system stress events. Allocation and management of resources in these periods requires a coordinated approach.	(A) Market decides (implicit) (B) System operators decide (C) System separation (decoupling)
Flexibility	1	Non-harmonised day-ahead market designs	DAY-AHEAD: Inefficient markets can result in underutilisation or adverse flows, particularly when price spreads between markets are small, thus preventing optimal utilisation of interconnector flexibility. Inconsistent market design hinders the achievement of market efficiency.	(A) Consider greater alignment with EU Day-ahead market coupling (B) Implement a new market with implicit price coupling, separate from SDAC (C) Multi-Region Loose Volume Coupling (MRLVC) (D) Explicit day-ahead auction
	2	Inefficient intraday market arrangements	INTRADAY: A standalone day-ahead market limits the ability to respond to market price changes closer to real-time, sometimes resulting in mismatched flows and missed opportunities to align with closer to real-time price signals.	(A) Consider greater alignment with EU Intraday market coupling (B) Integrate cross-border trading in the existing GB continuous intraday market (C) Consider greater alignment with EU's IDA markets (D) Multiple implicit intraday auctions (E) MRLVC with EU's IDA auctions
	3	Onshore system constraints limit IC ramping potential	RAMPING: Applying ramping limits on interconnectors results in reduced full utilisation of their flexibility. Nevertheless, unrestricted ramping is not operationally feasible for ensuring network security and reliability.	(A) Ramping change limit per Market Time Unit (MTU) (B) Dynamic ramping change limit per MTU (C) Adjusted ramping periods (D) Incentivise storage assets projects close to connection points

Operability	1	Inability to fully utilize IC capabilities for real-time response	REAL-TIME: By limiting the ability of interconnectors to deliver response and stability service, their potential contribution remains unutilised. Allowing access via markets could drive down costs and improve the efficiency of the markets by opening up competition.	(A) Direct participation in response markets (B) Provision of standard stability services, incl. inertia (C) Tailored products for ICs to provide frequency services (D) Tailored products for ICs to provide stability services (E) Co-location with dedicated assets
	2	Inability to access available reserves in neighbouring countries in the balancing timeframe	RESERVES: Interconnectors have the potential to expand the pool of available balancing providers but is hindered by the absence of proper market mechanisms and regulatory framework. This prevents access to potentially less expensive sources of balancing reserves.	(A) Join European coupled balancing markets (B) Establish new separate platform(s) for exchange of balancing services (C) Loose volume coupling for EU/GB balancing markets (D) Allocate IC capacity explicitly and enable rights holders to participate in balancing markets
	3	Planning of IC projects does not properly reflect operational needs	PLANNING: Planning of interconnector projects is mainly based on wholesale market price signals, with less focus on potential operational constraints, potentially exacerbating system performance issues.	(A) Locational market price signals (B) ESO to provide a CBA of different locations, to inform the Needs Case Assessment (C) ESO advising via Central Strategic Network Planning (CSNP)
	4	Scheduling of IC flows does not account for system constraints in an efficient way	SCHEDULING: Scheduling of interconnector flows is solely based on wholesale market price signals and does not account for system needs such as transmission constraints, potentially exacerbating operational cost	(A) Locational market price signals (B) ESO countertrading in an implicit intraday continuous market (C) Explicit intraday auction with allocated capacity (D) NTC restriction ‘as-is’ (E) NTC allocation based on common capacity calculation methodology
	5	Bespoke IC trilateral arrangements are inconsistent causing operational complexity	COORDINATION: The current interconnector arrangements between system operators lack consistency, are overly complex, and not transparent, which creates challenges for efficient operation of the interconnectors.	(A) Standardise agreements for new interconnector projects (B) Apply minimum requirements for specific IC Services for new ICs (C) Regulate services provided by interconnectors in the grid codes (D) Streamline SO-SO and emergency services across all ICs

ÅF and Pöyry have come together as AFRY. We don’t care much about making history.

We care about making future.

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