Consultation

Initial Project Assessment of the Third Cap and Floor Window for Electricity Interconnectors

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Response deadline:	31 May 2024
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This consultation provides our minded-to position on the Initial Project Assessment (IPA) for the seven interconnector projects that applied for a cap and floor regime in our third application window (Window 3). The IPA considers the needs case of the applicant projects to GB consumers. We welcome views from all interested stakeholders, and aim to take a final decision in summer 2024.

We will publish the non-confidential responses we receive alongside a decision, including next steps, on our website at ofgem.gov.uk/consultations. If you want your response – in whole or in part – to be considered confidential, please tell us in your response and explain why. Please clearly mark the parts of your response that you consider to be confidential, and if possible, put the confidential material in separate appendices to your response.

Contents

Executive Summary

Electricity interconnectors are the physical links that connect our electricity system with those of other countries and territories, enabling cross-border trade of electricity. Ofgem's cap and floor regime has been successful in attracting investment to increase interconnector capacity over the last decade. Electricity interconnectors to date have been beneficial to Great Britain's (GB) consumers mainly by giving GB access to cheaper electricity imports from mainland Europe. As we move to a decarbonised electricity system, and the further development of GB's exceptional wind resource in the future, we expect GB to become a net exporter of electricity as our wholesale price moves from being one of the highest to one of the lowest in Europe. Interconnectors are no longer expected to predominantly be a source of cheap electricity imports but instead a way of providing flexibility and enhancing security of supply in a renewables-dominated energy system.

The applicants for Window 3 were assessed using an expanded assessment framework to consider wider benefits of interconnectors beyond socioeconomic welfare (SEW), acknowledging interconnectors' potential to capture new security of supply and decarbonisation benefits, which bring additional value to consumers beyond the impact on wholesale prices. Additionally, we have placed more emphasis on the maturity and deliverability of projects compared to previous windows, assessing the capability of Window 3 projects to start operating prior to the end of 2032. Window 3 comes at a time when Ofgem is implementing or considering a range of reforms to network planning, and other policy options to adapt the grid to a decarbonised electricity system.

Alongside Window 3, we are also running a pilot regulatory process for Offshore Hybrid Assets (OHAs), which combine interconnection with the transmission of offshore wind. Our assessment of projects in both frameworks has been undertaken in parallel. We have published an equivalent IPA for our two pilot OHA projects alongside this consultation.[1]

About the projects

Seven applications were received for Window 3, which was open for applications between September 2022 and January 2023. We assessed the following projects for Window 3:

- Aminth (1.4GW to Denmark)

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[1] Please see the following link for the IPA consultation for the OHA pilot scheme: https://www.ofgem.gov.uk/publications/initial-project-assessment-offshore-hybrid-asset-pilot-projects

- AQUIND (2GW to France)
- Cronos (1.4GW to Belgium)
- LirIC (0.7GW to Northern Ireland)
- MaresConnect (0.75GW to Republic of Ireland)
- NU-Link (1.2GW to the Netherlands)
- Tarchon (1.4GW to Germany)

At the IPA stage, Ofgem assesses the projects' suitability for a cap and floor regime, and this document outlines our minded-to position on which interconnectors to grant a cap and floor in principle based on that assessment.

Our Minded-to Positions

We have assessed Window 3 projects in line with the Gas and Electricity Markets Authority ("the Authority")'s principal objective to protect the interests of existing and future consumers, including interests in compliance with the net zero carbon target.

We assessed applications in line with the Window 3 application guidance,[2] and needs case document[3] which set out our assessment framework, including:

- project maturity to become operational by the end of 2032
- socio-economic welfare impacts
- system operability and balancing market impacts
- decarbonisation
- security of supply, and
- hard to monetise impacts

The table below shows a summary of our minded-to positions for each project.

[2] Application Guidance for the Third Cap and Floor Window for Electricity Interconnectors | Ofgem
[3] Cap and Floor Third Application Window and MPI Pilot Regulatory Framework- Guidance on our Needs Case Assessment Framework | Ofgem

Table 1: Minded-to positions for the Window 3 IPA

Project	Our minded-to position	High-level reasons
Aminth	Reject	Deliverability, project currently appears unviable
AQUIND	Reject	Reservations surrounding high constraint costs
Cronos	Reject	Reservations surrounding high constraint costs and deliverability
LirIC	Reject	Reservations surrounding negative SEW
MaresConnect	Reject	Reservations surrounding negative SEW
NU-Link	Reject	Reservations surrounding deliverability
Tarchon	Approve	No material concerns identified

The Window 3 analysis confirmed the expectations of our Interconnector Policy Review[4] ('ICPR') that GB will become a net electricity exporter. While we expect GB prices overall to be much lower than today's levels in most scenarios,[5] exports will slightly increase GB wholesale prices, which shifts the balance of consumer and producer benefit. Our study shows that most Window 3 projects are beneficial to GB in total, when accounting for total socioeconomic welfare. However, this is driven by strong producer welfare, which offsets decreases in consumer and interconnector welfare.[6]

Through the export of renewable energy, all projects contribute to carbon savings across Europe, and contribute to balancing supply and demand in GB in an increasingly intermittent system by providing a route to market for surplus wind energy that would otherwise be curtailed. However, as the bulk of GB's wind resource sits in the north, the proposed location of most of the applicant interconnectors in the south means that most Window 3 interconnectors will substantially increase transmission system costs because of network bottlenecks. The positive decarbonisation and security of supply findings are often matched with a high constraint cost effect that we need to weigh against other factors in determining whether to approve an applicant project.

[4] Interconnector Policy Review - Decision | Ofgem
[5] The Future Energy Scenarios represent a range of different, credible ways to decarbonise our energy system to reach the 2050 target. Further detail can be found in Arup's market modelling report published alongside this consultation.
[6] Interconnector welfare is primarily affected by the change in revenue earned because of the variation in price differentials between the countries an interconnector connects to.

We are only minded to grant a cap and floor regime in principle to projects that deliver positively in all parts of our assessment. Our analysis suggests that Tarchon is expected to produce positive total welfare to GB, as well as providing benefits from a grid management and decarbonisation perspective. The constraint costs results provide Ofgem with reassurance that any future network reinforcements and non-network solutions would likely not place undue burden on GB consumers.

Next steps

We are now seeking views on our minded-to position, and welcome responses from all interested stakeholders. Stakeholders should submit responses to Cap.Floor@ofgem.gov.uk by **30 April 2024.**

We expect that a final decision will follow in summer 2024, and any cap and floor regime offered in principle will be subject to our IPA conditions. We will also follow up with publications on the detailed regime parameters for any successful Window 3 projects.

1. Introduction

Background to the cap and floor regime and the Initial Project Assessment

1.1 The cap and floor regime is the regulated route for interconnector development in GB, designed to facilitate the delivery of interconnection in a way that is economic, efficient and timely, whilst protecting consumers' interests.

1.2 It provides interconnectors with a cap and floor to regulate revenues. A minimum level of revenue is provided by consumers if the generated interconnector revenues are lower than the floor level.[7] Where the generated interconnector revenues are above the cap level, the developer would need to pay back revenues in excess of the cap to consumers. Interconnectors may also be delivered and operated under the merchant-exempt regulatory route, under which the interconnectors are exempted from specific regulatory and legal requirements, but their developers and operators bear the project development and operational revenue risks.

1.3 Cap and floor regime approvals are granted through investment windows rather than in response to ad hoc applications. Following the cap and floor pilot with the Nemo Link project, we have launched two cap and floor windows, one in 2014, and one in 2016, and took forward eight projects through both windows. Following this, we conducted the Interconnector Policy Review in 2020-21,[8] to determine the effectiveness of the cap and floor regime and to consider changes to the assessment process and to the regime for future projects. Window 3 was then launched for applications in September 2022 and closed in January 2023.[9]

1.4 In tandem with Window 3, we launched a pilot scheme for Offshore Hybrid Assets (OHAs), referred to at the time as Multi-Purpose Interconnectors (MPIs). The details of the IPA for this scheme are published in a separate document alongside this consultation.[10]

1.5 Following the IPA decision, each cap and floor project is held to IPA conditions, which are part of the IPA decision, and are intended to incentivise timely delivery of projects and to ensure that consumers realise the anticipated benefits that informed

[7] Floor payments are contingent on interconnector availability meeting the requirements of our minimum availability threshold.
[8] Open letter: Notification to interested stakeholders of our interconnector policy review | Ofgem
[9] Application Guidance for the Third Cap and Floor Window for Electricity Interconnectors | Ofgem
[10] Initial Project Assessment of the Offshore Hybrid Asset Pilot Projects

our decision on the needs case for the project at IPA stage. We then carry out the Final Project Assessment (FPA) to determine the specific cap and floor levels for each project before it reaches financial close and can begin construction, as well as insert special licence conditions into the interconnector licence held by the licensee. Finally, we carry out the Post-Construction Review to determine the final cap and floor levels, taking into account our final assessment of the project's costs.[11]

Overview of the Window 3 interconnector projects

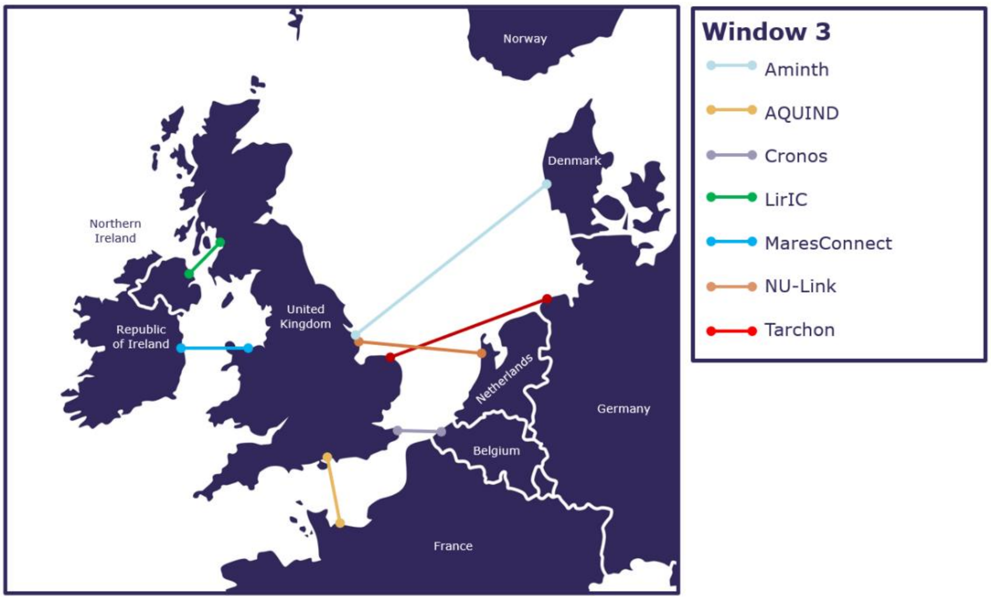
1.6 We determined that the following applicant projects were eligible for assessment at the IPA stage in February 2023.[12]

Table 2: Main characteristics of the Window 3 projects

Project	Developer	Location	Capacity
Aminth	Copenhagen Infrastructure Partners	Mablethorpe, Lincolnshire, GB, to Danish Energy Island	1.4GW
AQUIND	AQUIND LIMITED	Lovedean, Hampshire, GB to Barnabos, Normandy, France	2GW
Cronos	Copenhagen Infrastructure Partners	Kelmsley, Kent, GB, to Belgium	1.4GW
LirIC	Transmission Investment	Kilmarnock South, Scotland, GB to Kilroot, Northern Ireland	0.7GW
MaresConnect	MaresConnect Limited	Bodelwyddan, North Wales, GB, to Republic of Ireland	0.75GW
NU-Link	NU-Link Consortium	Mablethorpe, Lincolnshire, GB, to Vijfhuizen, Netherlands	1.2GW
Tarchon	Copenhagen Infrastructure Partners	East Anglia[13], GB, to Niederlangen, Germany	1.4GW

[11] Relevant provisions are included in Special Condition 8: Process for determining the value of the post construction adjustment terms.
[12] Decision on project eligibility for the Third Cap and Floor Window for Electricity Interconnectors | Ofgem
[13] 'East Anglia' substation refers to a substation yet to be constructed, identified as an optimal location point in GB by the CION process conducted by NGESO for the Tarchon project. More detail follows in Section 4.

Figure 1: Map showing indicative connection points for the Window 3 applicant projects



1.7 The Window 3 applicant projects propose a cumulative connection capacity of 8.85GW across the seven projects. GB currently has 11.7GW already operational or under construction today,[14] and Government's ambition is to deliver at least 18GW of interconnection by 2030.

What are we consulting on?

1.8 This consultation contains our minded-to position on our IPA of the seven projects listed above, along with the supporting analysis and reasoning for our position. Alongside this consultation we have published the detailed results and methodology of components of the analysis conducted for the IPA: the Market Modelling report, prepared by our consultants at Ove Arup and Partners ("**Arup**"), and a system impacts report, prepared by National Grid Electricity System Operator (NGESO).[15]

[14] At the time of publication, Viking Link is operating at a reduced capacity of approximately 0.8GW. The 11.7GW includes Viking Link operating at full 1.4GW capacity.
[15] Please note that 'NGESO' and 'ESO' are used interchangeably across the consultation and accompanying reports to refer to GB's Electricity System Operator.

Related publications

Context behind the introduction of Window 3 and the OHA pilot scheme

Decision on the Initial Project Assessment of the GridLink, NeuConnect and NorthConnect interconnectors | Ofgem

Interconnector Policy Review: Decision (ofgem.gov.uk)

Targeting Analysis for the Third Cap and Floor Window and MPI Pilot Regulatory Framework | Ofgem

Application Guidance for the Third Cap and Floor Window for Electricity Interconnectors | Ofgem

Cap and Floor Third Window and MPI Pilot Needs Case Framework (ofgem.gov.uk)

Decision on project eligibility for the Third Cap and Floor Window for Electricity Interconnectors | Ofgem

Consultation on changes to the financial parameters of the cap and floor regime for window 3 electricity interconnectors and risk considerations for offshore hybrid assets | Ofgem

Accompanying publications

1.9 This minded-to consultation is published alongside reports supporting our IPA based on analysis undertaken by Arup and NGESO. These reports are as follows:

- ‘**Market Modelling Analysis** for Cap and Floor W3 and Offshore Hybrid Assets Pilot Projects’ - Arup
- ‘**Multi-Criteria Assessment framework** report for Cap and Floor W3 and Offshore Hybrid assets Pilot Projects’ - Arup
- ‘**ESO Modelling Report**: Cap and Floor Window 3 and Offshore Hybrid Asset pilot scheme Needs Case Assessment’ – NGESO

Consultation stages

1.10 The consultation will remain open for 9 weeks for written responses until 3 May 2024, following which we anticipate publishing our decision in summer 2024.

Figure 2: Consultation stages

Stage 1	**Stage 2**	**Stage 3**	**Stage 4**
Consultation open	Consultation closes	Responses reviewed and published	Consultation decision
01/03/2024	30/04/2024	Q2 2024	Summer 2024

How to respond

1.11 We want to hear from anyone interested in this consultation. Please send your response to the person or team named on this document's front page.

1.12 We've asked for your feedback in each of the questions throughout. Please respond to each one as fully as you can.

1.13 We will publish non-confidential responses on our website at www.ofgem.gov.uk/consultations.

Your response, data and confidentiality

1.14 You can ask us to keep your response, or parts of your response, confidential. We'll respect this, subject to obligations to disclose information, for example, under the Freedom of Information Act 2000, the Environmental Information Regulations 2004, statutory directions, court orders, government regulations or where you give us explicit permission to disclose. If you do want us to keep your response confidential, please clearly mark this on your response and explain why.

1.15 If you wish us to keep part of your response confidential, please clearly mark those parts of your response that you *do* wish to be kept confidential and those that you *do not* wish to be kept confidential. Please put the confidential material in a separate appendix to your response. If necessary, we'll get in touch with you to discuss which parts of the information in your response should be kept confidential, and which can be published. We might ask for reasons why.

1.16 If the information you give in your response contains personal data under the General Data Protection Regulation (Regulation (EU) 2016/679) as retained in domestic law following the UK's withdrawal from the European Union ("UK GDPR"), the Gas and Electricity Markets Authority will be the data controller for the purposes of GDPR. Ofgem uses the information in responses in performing its statutory functions and in accordance with section 105 of the Utilities Act 2000. Please refer to our Privacy Notice on consultations, see Appendix 4.

1.17 If you wish to respond confidentially, we'll keep your response itself confidential, but we will publish the number (but not the names) of confidential responses we receive. We won't link responses to respondents if we publish a summary of responses, and we will evaluate each response on its own merits without undermining your right to confidentiality.

General feedback

1.18 We believe that consultation is at the heart of good policy development. We welcome any comments about how we've run this consultation. We'd also like to get your answers to these questions:

i. Do you have any comments about the overall process of this consultation?

ii. Do you have any comments about its tone and content?

iii. Was it easy to read and understand? Or could it have been better written?

iv. Were its conclusions balanced?

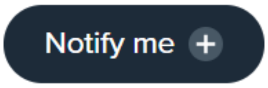
v. Did it make reasoned recommendations for improvement?

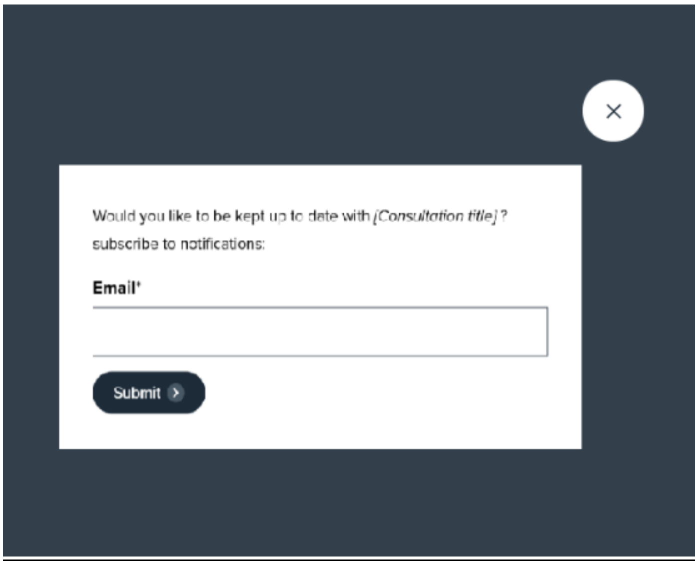
vi. Any further comments?

Please send any general feedback comments to stakeholders@ofgem.gov.uk

How to track the progress of the consultation

1.19 You can track the progress of a consultation from upcoming to decision status using the 'notify me' function on a consultation page when published on our website. Ofgem.gov.uk/consultations





Once subscribed to the notifications for a particular consultation, you will receive an email to notify you when it has changed status. Our consultation stages are:

Upcoming > **Open** > **Closed** (awaiting decision) > **Closed** (with decision)

2. The strategic case for future interconnection

Section summary

In a decarbonised future electricity system, we expect that further interconnectors will likely be net exporters, resulting in lower consumer welfare and a marginal rise in the wholesale price in GB.

Despite this, some future interconnection would likely remain in the consumer interest, as it is likely there are additional benefits to be gained from interconnectors in meeting national and international policy goals related to decarbonisation, flexibility and renewable energy integration.

The energy landscape is changing due to the rapid transition to low-carbon energy sources and the related implementation of market reforms. Some policy reforms may change the strategic case for future interconnection. We are alert to this and have taken into account known changes and reforms where possible, and further discuss uncertainties in policy and market frameworks where some options might be particularly relevant to our assessment.

Benefits of interconnection

2.1 The economics of interconnectors in GB are changing. At the time of the introduction of the cap and floor regime, interconnectors were considered beneficial to GB consumers, primarily by increasing wholesale market competition and enabling imports of cheaper electricity from Europe. However, GB's renewables rollout means that under most future scenarios we anticipate that our electricity wholesale price will likely move from being one of the highest to one of the lowest in Europe. This means that it is expected that interconnectors will serve a different purpose, as a way of providing flexibility to our renewables-dominated energy system. In principle, interconnectors can provide the following benefits to GB:

- **Lower prices for consumers.** Electricity trading through interconnectors allows access to cheaper electricity from neighbouring countries, and more efficient generation dispatch, reducing the overall cost of energy across markets. This has been the main historic driver for new interconnection. However, whilst general efficiency benefits will remain, we expect that the GB consumer benefit is likely to change as GB becomes a net exporter of electricity.

- **Diversification of GB's energy sources.** Interconnectors provide access to a wider range of generation. This diversification can enhance energy security by reducing dependence on a more limited range of domestic sources. Interconnectors can facilitate the integration of other renewable sources into the grid through imports, or export excess wind energy to another country with high demand. This helps in optimising the use of renewables, enabling regional specialisation (by locating different types of renewables in areas where they are most efficient) and unlocking a more sustainable energy mix.

- **Ability to balance supply and demand, including providing a route to export renewable energy that would otherwise be curtailed.** Interconnectors can help manage fluctuations in renewables output, by importing or exporting as needed. This can contribute to a more stable and reliable electricity grid if they are located in the right place. In practice, the current operation of interconnectors is proving challenging given limited price signals in the wholesale market and complex cross-border balancing arrangements.

- **Enabling countries to share excess capacity during peak demand periods**. This can be more cost-effective than building additional domestic infrastructure to meet occasional high demand.

- **Enhancing grid resilience by providing backup options.** We have seen numerous examples where the system operator has used interconnectors, sometimes under emergency instruction, to alleviate incidents that would otherwise have led to major demand outages. Between July 2022 and March 2023 interconnectors played a significant role on six occasions responding to Capacity Market Notices, price spikes driven by low wind, and NGESO's Demand Flexibility Service.[16]

- **International collaboration towards strategic energy policy goals.** In future we expect interconnectors to increasingly become part of a meshed North Sea grid, coordinating the connection of offshore wind farms and enabling cross border flows. This has already been highlighted as a priority approach for countries with limited coastlines. There will be significant strategic value in

[16] For more information regarding data sources behind this, please see Elexon's BMRS portal for generation data including interconnector flows; NGESO's capacity market notices available at GB Electricity Capacity Market Notices - National Grid (nationalgrideso.com), and price data from Nord Pool available at: Nord Pool (nordpoolgroup.com).

coordinated development internationally to reach offshore wind ambitions for 2050.

2.2 It should be noted that some of the above benefits relating to security of supply and flexibility are sometimes not realised in the operation of interconnectors under the current landscape. This is expected to be mitigated through the participation of OHAs and interconnectors in ancillary services, which is currently voluntary, as well as through either more centralised network planning and/or wholesale market reforms detailed below.

Outcomes of our Interconnector Policy Review and our expectations for Window 3

2.3 In August 2020, Ofgem launched the ICPR to investigate its approach to further interconnection and evaluate the effectiveness of the cap and floor regime. The decision, published in December 2021, signalled our intention to run Window 3 for interconnectors alongside a pilot scheme for OHAs.

2.4 The ICPR concluded that going forward, as GB is predicted to become a net exporter of renewable energy, further interconnection capacity could result in higher wholesale prices than would otherwise be the case. In such cases we would expect the allocation of welfare between consumers and producers to change, with further interconnection potentially resulting in lower consumer welfare and higher producer welfare due to the export of electricity increasing GB wholesale prices. Nonetheless, it was identified that the total welfare impact of projects could be expected to remain positive, as modelled through a 2020 AFRY study that constituted part of the ICPR analysis.[17] Therefore, the decision to open Window 3 was on the basis that future interconnection would likely remain in the consumer interest due to the role interconnectors could play in delivering a decarbonised energy system, and it was decided to expand the needs case assessment to further explore these wider impacts of interconnectors beyond socioeconomic welfare, such as carbon savings and system flexibility and operability.

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[17] Interconnector policy review: Working paper for Workstream 2 – socio-economic modelling | Ofgem

Interaction with other market reforms

2.5 The ICPR took place alongside wider reviews of network planning and delivery in GB. In January 2021, Ofgem published the **review of GB energy system operation**.[18] This recommended to Government that the system operators are given additional responsibilities and that the system operator for electricity is made fully independent from the transmission network owner. Subsequently, a joint consultation with the Department for Energy Security and Net Zero (then the Department for Business, Energy & Industrial Strategy (**BEIS**)), [19] proposed the creation of an independent system operator, known as the **Future System Operator** (now called the National Energy System Operator (**NESO**)). [20]

2.6 The introduction of the NESO will enable a more strategically planned transmission network by taking on an increasingly significant role in strategic network planning and in facilitating competition. This includes responsibility for the new **Centralised Strategic Network Plan** (**CSNP**).[21]

2.7 In the CSNP, the NESO will initially focus on the GB electricity transmission network – onshore, offshore and interconnectors, as well as gas transmission and the proposed hydrogen network. The NESO will also make recommendations on how the system should develop to decarbonise the electricity system by 2035, which is critical for meeting the UK's overall 2050 Net Zero target.

2.8 In addition to the change towards centralised network planning, plans were developed in 2022 to accelerate and coordinate the construction of specific network infrastructure projects that would become operational in the 2030s. These plans consist of the **Holistic Network Design** (**HND**)[22] for offshore developments, and the **Accelerated Strategic Transmission Investments** (**ASTI**)[23] programme onshore. The Holistic Network Design Follow Up Exercise (**HNDFUE**) is in development for additional offshore wind to be published in Spring 2024.[24]

[18] Review of GB energy system operation | Ofgem
[19] Consultation on proposals for a Future System Operator role | Ofgem
[20] Previously denoted as the Future System Operator (or FSO), the new National Energy System Operator (NESO) will be the independent, public corporation responsible for planning Britain's electricity and gas networks and operating the electricity system
[21] Centralised Strategic Network Plan: Consultation on framework for identifying and assessing transmission investment options | Ofgem
[22] The Pathway to 2030 Holistic Network Design | ESO (nationalgrideso.com)
[23] Decision on accelerating onshore electricity transmission investment | Ofgem
[24] Holistic Network Design Follow-Up Exercise | ESO (nationalgrideso.com)

2.9 Finally, the UK Government's ongoing **Review of Electricity Market Arrangements** (**REMA**)[25] aims to identify and implement reforms to GB electricity market arrangements to unlock the necessary investment and drive efficient operation of a secure, low carbon, electricity system. In order to support the UK Government's REMA programme, in April 2022 Ofgem began an assessment of the potential impacts of implementing **locational wholesale pricing in GB**.[26] The resulting analysis, published by Ofgem in October 2023, showed that locational pricing has the potential to significantly change the behaviour of operational interconnectors and the needs case for future interconnections. It also showed that the alternative price differentials in a zonal GB market[27] would mean interconnectors could flow more efficiently and reduce constraints alongside the associated costs to balance the system. We have not considered the potential impacts of locational pricing in our assessment of projects as it remains uncertain whether locational pricing will be implemented – and if so, which design option might be taken forward and on which timeline. However, the work to date demonstrates that any change in wholesale market arrangements could have a material impact on interconnector flows and operation.

2.10 Early development of the above policies was concurrent with the ICPR process and the launch of Window 3. The ICPR decision in December 2021 announced the long-term intention to target future windows with particular attention to desired location, timing, and capacity, whilst continuing to work to work with the relevant programmes to ensure that interconnector regulatory needs are considered as strategic network planning frameworks are developed.

2.11 As stated in the ICPR, the initial intention was to launch Window 3 as a locationally-targeted[28] window pending analysis from NGESO. However, in our targeting document published in August 2022[29], Ofgem noted that we would not restrict applications to Window 3 or the OHA pilot scheme based on location. We noted that

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[25] Review of electricity market arrangements | GOV.UK (www.gov.uk)
[26] Under locational pricing, wholesale prices reflect the locational value of energy at different points across the network. For more information, please see: Assessment of locational wholesale pricing for Great Britain | Ofgem
[27] Instead of having one wholesale electricity price, GB could be split into a few zones with their individual zonal prices.
[28] Locational targeting would mean we would invite interconnectors proposing to connect to specific locations to apply for the window and exclude other proposals. By launching a locationally-targeted window we would seek to ensure that our application window brings forward the right projects in the right locations, at the right time for consumers when thinking about the GB energy system.
[29] Targeting Analysis for the Third Cap and Floor Window and MPI Pilot Regulatory Framework | Ofgem

a project's location and support from the relevant authorities of the connecting country / jurisdiction would be considered closely throughout the needs case assessment. The impact of an interconnector on network constraints is dependent not only on its location in GB, but also on supply and demand assumptions, expected flows, wholesale price dynamics, and the other interconnectors in the baseline. Given this variability, it was considered more appropriate to assess the system impacts of applicant interconnectors knowing the full picture of specific projects, as opposed to using high-level analysis to exclude certain interconnectors from applying for Window 3. Nonetheless, the NGESO targeting analysis provides important context which we encouraged developers to take into account for their submissions. NGESO's modelling analysis highlights that additional interconnection may have a significant impact on nationwide constraint costs, however this is highly dependent upon location and import/export status of the interconnector.

3. Structure of the IPA

Section summary

For our IPA stage for Window 3 we increased our scrutiny of maturity and deliverability compared with previous windows. We also included new quantified indicators in the market modelling on a project's decarbonisation and security of supply impact that were previously explored in less detail.

The IPA consists of three components: the maturity and deliverability analysis, market modelling, and the system impacts. Decision making is not weighted across these three components.

3.1 The IPA for Window 3 is informed by analyses from Ofgem, NGESO, and Arup. Specifically, NGESO provide the system impacts analysis; and Arup provide market modelling analysis and a 'Red-Amber-Green' (RAG) rating for the hard to monetise impacts.[30] These analyses are presented together in the multi-criteria assessment (MCA) framework report published by Arup alongside this consultation. Alongside this, we have assessed the maturity and deliverability of the projects. We also provide a final assessment of the hard to monetise impacts identified by Arup. The component parts of our assessment are presented below and explored in more detail in this section.

The components of Ofgem's IPA

Multicriteria assessment (MCA) Framework Report

System impacts analysis

The indicators for this analysis are as follows. This is provided by NGESO.

1. Frequency stability
2. Frequency response savings
3. Voltage stability
4. Reactive response savings
5. Restoration (black start)
6. Constraint costs

[30] Please note that the term 'hard to monetise costs' was used within the Window 3 application guidance, but is otherwise known as 'hard to monetise impacts'.

7. RES integration (avoided RES curtailment/spillage)[31]

Electricity market modelling analysis[32]

The indicators for this analysis are as follows. This is provided by Arup.

1. RES integration (additional RES capacity)
2. CO2 reduction (SEW)
3. CO2 reduction (societal value)
4. Overall decarbonisation
5. Consumer SEW
6. Producer SEW
7. Interconnector SEW
8. Total SEW[33]
9. Security of supply; cost of expected energy not served

Hard to monetise impacts

Arup also provide an assessment of hard to monetise impacts within the MCA report. An additional assessment on HtM impacts is also provided in Ofgem's deliverability and maturity analysis below. The indicators for this analysis are as follows:

1. Environmental
2. Local community
3. Noise/disturbance
4. Landscape
5. Other impacts

Ofgem deliverability and maturity analysis

The indicators for this analysis are as follows. This is provided by Ofgem.

1. Qualitative assessment of risks and dependencies
2. Hard to monetise impacts
3. Project plans

[31] This refers to the level of RES curtailment that would be avoided due to the addition of an interconnector or OHA, and was calculated by NGESO as they were deemed the most appropriate party to do so given that they are the monopoly owner of the full scale of data on the GB network.
[32] The market modelling, although conducted by Arup, is informed by select data submitted by developers. The figures for onshore costs included in a developer's CION and the indicative capex costs submitted by developers are inputs which inform the SEW outputs. More information on onshore costs is explained on page 45.
[33] Total SEW is composed of GB consumer, GB producer and GB interconnector SEW. 'Total SEW' and 'total welfare' are used interchangeably in this consultation.

4. Plans for grid connection in connecting country
5. Plans for obtaining regulatory approval in the connecting country
6. Justification of connection location, cable route, capacity and technical design
7. System operability
8. Financing plans
9. Supply chain plans

Ofgem's decision-making

3.2 It is important to note that Window 3 for point-to-point interconnectors and the OHA pilot scheme are two separate investment windows which offer separate regimes and have separate criteria. These two separate IPA processes are being run concurrently and the projects were assessed in the same market modelling and system impact modelling, as the projects are being built to the same timelines and will have tangible impacts on each other that need to be accounted for. Not doing so would have provided less rigorous results.

3.3 The IPA is not weighted nor mechanistic. The final decision on whether to award a cap and floor regime in principle is taken by the Authority with regard to the Application Guidance for Window 3 and the Authority's principal objective. The Authority's principal objective, contained in section 3A of the Electricity Act 1989, is to protect the interests of existing and future consumers, including their interests in the Secretary of State's compliance with the duties in sections 1 and 4(1)(b) of the Climate Change Act 2008 as well as their interests in the security of the supply of electricity to them.

3.4 The market modelling analysis and system operability analysis are considered as distinct pieces of the IPA, which are presented together within the MCA provided by Arup. The MCA does not calculate an aggregate SEW for each project by collating these inputs due to the inherent differences in the analyses owed to the different modelling software used.

3.5 During the IPA, the projects are assessed on their own merits and their results are not directly compared against each other. We look to offer a cap and floor regime, in principle, to any project that we consider to be in the consumer interest and deliverable prior to the end of 2032.

Changes between Window 3 and previous windows

3.6 To further develop our assessment of projects and to align with the outcomes of the ICPR, we have introduced some changes to the way we assess projects for Window 3.

Maturity

3.7 Compared to Windows 1 and 2, Ofgem requested that more mature projects come forward for Window 3, demonstrating they can meet a specific timeline of reaching operations by the end of 2032. To ensure projects are well-prepared to meet that timeline, we have accordingly strengthened certain assessment criteria. For example, the obligation for developers to provide 'plans for regulatory approval in the connecting country' (sections 1.13-1.14 in the Application Guidance), and 'plans for grid connection in the connecting country (section 1.15 in the Application Guidance) have been made stand-alone criteria under the Window 3 guidance, with a greater level of evidence being requested. Previously, for Window 2 Ofgem requested up-to-date evidence of discussions and engagement with the relevant regulatory authorities and governmental departments in the connecting states, under the 'project plans, supply chain plans and financing plans' criterion.[34]

3.8 This change reflects our experience with interconnector projects of Window 1 and 2, for which securing regulatory approval in the connecting states is a common cause of delay to a project's development and construction. Therefore, for Window 3, to mitigate risks of delays as far as possible we look for projects that can provide sufficient evidence of proactive steps to obtaining a grid connection and regulatory approval in the connecting country as well as GB. This is to provide Ofgem with sufficient confidence that the project can be operational prior to the end of 2032.

3.9 As part of the application guidance for Window 3, Ofgem provided examples of material we would want to see included in the submissions as evidence to give us sufficient confidence that the projects could be delivered by the end of 2032.[35]

System impacts

3.10 Window 3 takes a step closer towards aligning interconnector windows with evolving approaches to strategic network planning. In our targeting analysis from August

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[34] For more information on the submission material for Window 2, please see page 8: Decision to open a second cap and floor application window for electricity interconnectors in 2016Ofgem

[35] Please see Appendix 1 for information of submission material for Window 3: Summary of the Third Cap and Floor Application Window for Electricity Interconnectors Ofgem

2022, we decided not to exclude interconnectors connecting to specific locations from applying for Window 3. However, we have sought to provide more transparency on NGESO's constraint costs (balancing market impacts) analysis in this window compared to Windows 1 and 2.

Wider impacts quantification

3.11 In previous windows, the market modelling consisted primarily of the SEW. For Window 3 the market modelling has been expanded to account for wider impacts. Indicators measuring carbon savings and reduction of unserved energy (USE) hours are new to this application window. It should be noted that the calculation of the headline SEW in previous windows includes the local constraint costs and costs of onshore works within this figure. The cost of onshore works has not been included in Window 3 results, however, we are working with NGESO to source robust and up-to-date estimates for these inputs. This is expanded upon later in this section.

Modelling study submitted by applicants

3.12 In previous windows, Ofgem compared its own modelling study to studies submitted by developers. Developer submission of a modelling study was made optional in Window 3. Developer-submitted modelling studies serve as complementary to Ofgem's own market modelling, however they are not used as a replacement. The purpose of the developer-submitted modelling studies in Window 3 was to enable Ofgem to consider different modelling approaches, assumptions and scenarios for use in Ofgem's modelling, at the stage of the modelling workshops and finalisation of the methodology. Beyond the finalisation of the methodology, the developer modelling studies are not used further in the assessment process of the IPA.

Deliverability and maturity analysis

3.13 This section of the IPA captures all qualitative data submitted to Ofgem that cannot be captured within the aggregated modelling,[36] and helps us to understand a project's maturity and ability to become operational prior to the end of 2032 as per the timeline for Window 3.

3.14 It is important to note that the timelines and incentives decision for Window 3 means that if a project faces material changes to their project's timelines, designs, or costs, they may face penalties and Ofgem, in any event, reserves the right to

[36] This is with the exception of the qualitative assessment of hard to monetise impacts which are included within Arup's MCA.

undertake a review of an IPA decision.[37] The maturity assessment helps Ofgem to avoid awarding a cap and floor regime in principle to a project that may face such material changes to its circumstances, by assessing with higher scrutiny the plans it has made prior to applying for a cap and floor regime.

3.15 In the Window 3 Application Guidance we detailed the submission requirements, which included a project plan, financing strategy, assessment of risks and dependencies, assessment of hard to monetise impacts, supply chain plans, justification of the cable route, capacity and technical design, and written evidence of positive engagement with the connecting country Transmission System Operator (TSO), and National Regulatory Authority (NRA) and/or government, as appropriate, in the connecting country.

Scoring of projects

3.16 We apply a RAG rating[38] to each submission material area that was requested in our Application Guidance for Window 3, based upon how well-prepared a developer is to become operational prior to the end of 2032.[39] This includes how strong a developer's understanding is of the milestones required in their project's development to reach final investment date and to commence construction; how well a developer is sighted of potential risks, with details of mitigations, and whether the views of decision-making parties such as the connecting country NRA and TSO on milestones, approach and timings are aligned with that of the developer. This helps Ofgem identify if there are significant obstacles to a project's development which could be likely to lead to delays to the connection date as proposed by the developer in their application that would threaten the project's capability to become operational by 2032.

3.17 Our RAG rating is defined as follows:

- **Green**: we do not have material concerns on this criterion based on the information received.

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[37] [Decision on Timelines and Incentives changes for the Third Cap and Floor Window for Interconnectors | Ofgem]

[38] RAG ratings, also known as a 'traffic light ratings' are used to demonstrate performance. In general, green is used to denote 'good' performance, amber is used to demonstrate concern of moderate severity, and red indicates that there is significant cause for concern. Further detail of Ofgem's specific adoption of this can be found below.

[39] Please note that the submission material included a 'project overview'. This is not discussed in this consultation given that this was for informative purposes to provide the project background. Projects received a green in this area for providing the information, and a red would indicate the material was absent.

- **Amber**: we have concerns of moderate severity around the project's maturity, but our current view is that these concerns could be managed by the developer.
- **Red**: we have serious concerns about the project's maturity and ability to connect prior to the end of 2032, based upon the evidence submitted for this criterion, or material changes to the project that have occurred since submission of which the developer has notified us.

3.18 The maturity analysis is designed to assess a project's likelihood of connecting prior to the end of 2032, based on preparations and work that the developer had conducted at the point of submitting the Window 3 application, alongside taking into account any material developments since this time (notified by the developer to Ofgem or noticed by Ofgem and later explained by the developer upon Ofgem's request).

3.19 We recognise the following factors vary from project to project:

- There is scope for projects to change and develop in the time between now and 2032.
- Projects are at different stages in terms of steps taken in the development process prior to application, or time and money invested.
- Projects have different proposed connection dates.
- The differing legislative frameworks and modes of engagement that interconnectors are subject to depending on their chosen connecting country.

3.20 The IPA criteria are designed to take these factors into account and treat projects fairly and objectively. For example, as a measure of plans for regulatory approval in the connecting country, we consider the alignment between the understanding of the NRA, Government or TSO and the understanding of the developer, as opposed to prescribing the submission of standardised evidence of engagement, such as a letter of support.[40] Additionally, maturity should not be viewed as being equal to time or money invested in a project to date – neither of which brings certainty of delivery within the required timeframe. Rather, maturity is evidenced by the developer's consideration of obstacles to project development and how the developer (and other relevant authorities) envisions these can be overcome.

[40] See page 27 of the Application Guidance: Summary of the Third Cap and Floor Application Window for Electricity Interconnectors | Ofgem

Scoring of justification of location and technical design

3.21 The 'justification of connection location, capacity and design' section of the maturity analysis is derived both from a developer's application and the Connections and Infrastructure Options Note (CION) completed by NGESO's and submitted as part of the developer's application. Ofgem considers that the CION for every project applying under Window 3 is likely to be outdated to some extent (and in some cases materially outdated) due to rapid changes to connections and system planning processes and the contracted background. This affects how we can use this information for our assessment. The CIONs for Window 3 projects were conducted between 2016 and 2022 with generation backgrounds of 2014 or 2018, which predate the large strategic investment programme of the Holistic Network Design (HND). With this in mind, we have assessed each developer's justification of its chosen technical designs and locations based on how thorough a developer has been in its engagement with NGESO in considering the optimal connection locations and designs to reduce costs and/or maximise benefit, and how well each developer has accounted for risk. Otherwise, we have discounted evidence derived from the CION which the developer would not have been able to obtain otherwise, and only assessed applications for this criterion in aspects that go as far as developers can control.

Scoring of hard to monetise impacts

3.22 As part of the submission material for Window 3, developers were asked to submit details of the project's hard-to-monetise (HtM) impacts (also known as HtM 'costs'), covering environmental, landscape, noise and local community impacts. These are important to capture because they can provide a more holistic understanding of the potential impact of a project on the surrounding area in GB to which it proposes a connection. This also serves to make Ofgem aware of any risks to project construction and connection and how the developer is handling any such risks.

3.23 These hard to monetise indicators are included within the MCA we commissioned Arup to lead. Arup's Multi-Criteria Assessment (MCA) report considers these impacts by providing a RAG rating against each of them. We expand on the interpretation of these results in the individual project results sections. Arup only assessed the content of the project submissions. Ofgem have subsequently added to Arup's view accounting for material developments which have taken place after a project's submission, either notified to us by a developer, or that Ofgem has noticed and then informed a developer to comment on. The RAG ratings displayed in this document for this criterion is Ofgem's final scoring, accounting for Arup's view.

MCA framework and report

3.24 Following our ICPR decision, Ofgem procured advisors from Arup in 2022 to develop an updated methodology for our IPA. Arup provided suggestions on how to account for impacts of interconnectors from a whole-system perspective through a new multicriteria assessment (MCA) framework.[41] Their work draws upon best practice across other sectors.[42] It also identifies roles and responsibilities, identifying which organisation is best placed to undertake analysis or provide data, between Ofgem, Arup, NGESO, and applicants.

3.25 Ofgem took on board Arup's proposed methodology, alongside feedback from two developer workshops between May and June 2023, and the MCA framework has been used for Window 3. The MCA quantifies indicators that were deemed hard-to-monetise in previous windows, and indicators are grouped in seven categories: socioeconomic welfare, onshore costs, system operability impacts, flexibility impacts, decarbonisation, security of supply and hard to monetise impacts (defined for Window 3 as noise, environment and local community impacts).[43]

3.26 We procured Arup to lead the MCA framework exercise and conduct the market modelling analysis required for it. In addition, Ofgem requested NGESO to undertake a system impact analysis to obtain various indicators that would later be included in the MCA.

3.27 Ofgem, in collaboration with Arup and NGESO, held two workshops with Window 3 applicants between May and June 2023 to consult developers on the methodology and key assumptions of the MCA and market modelling. Stakeholder feedback was duly noted and considered by Ofgem alongside the views of Arup and NGESO in reaching a final position on the methodology and assumptions. A 'methodology note'

[41] The MCA report produced by Arup can be found in the documents accompanying this consultation on Ofgem's website.
[42] Arup's 2022 Needs Case Assessment Framework: Needs Case Assessment Framework Arup Report | Ofgem
[43] For detail of the indicators used and the party conducting the analysis, please see Table 1 on Page 13 of Ofgem's guidance: Cap and Floor Third Window and MPI Pilot Needs Case Framework | Ofgem

explaining the final methodology was circulated among applicants in August 2023, and this has been published along with Arup's report.[44]

Ofgem's considerations on the MCA framework

3.28 The main purpose of the MCA framework is to facilitate Ofgem's interpretation of a project's results by bringing together information that is collected from different sources. Through the MCA framework, Arup have provided a RAG rating for each indicator, wherein the rating reflects the number of scenarios where a project demonstrates a positive result against a particular indicator.[45]

3.29 The RAG ratings assist Ofgem's understanding of how projects perform across the range of indicators and selected scenarios. We note this approach is an update from our initial approach where we intended to rate indicators based on a high, base, low case categorisation of the selected FES scenarios. We introduced this change in response to developers' feedback that the FES scenarios were not specifically designed to represent different values of interconnector projects.[46]

3.30 We have chosen not to weight results from any particular scenario or indicator in a mechanistic manner. This is to ensure sufficient discretion in reaching a final decision on whether to award a cap and floor regime in principle with regard to the Application Guidance for Window 3 and GEMA's principal objective of protecting the interests of existing and future consumers.

3.31 We have individually considered all indicators in the MCA in our decision-making as opposed to aggregating them into a single figure. The stated intention prior to the analysis was to bring the quantifiable indicators as calculated by Arup and NGESO together into an aggregate SEW figure. However, after undertaking the analysis, Ofgem reflected that bundling a range of indicators into a single figure could compromise the quality and integrity of the results. The results across Arup and NGESO's modelling differ slightly due to the inherent differences of the modelling software used. Further detail on this reasoning can be found in Arup's MCA report published alongside this document.

3.32 We also stated prior to our analysis that we intended to use the aggregate SEW figure to shortlist projects, but since the calculation of this was no longer possible,

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[44] For further detail please refer to Arup's and NGESO's reports, which are published alongside this document.
[45] Please note that this excludes 'hard to monetise impacts' whereby the RAG ratings are not dependent on the scenarios.
[46] More information can be found in Arup's MCA report published alongside this report.

we decided not to use this measure to shortlist projects in our assessment. The existence of an aggregate SEW indicator, encompassing all monetisable indicators, was fundamental to the shortlisting approach and it may have been detrimental to exclude a project from the full MCA process based on one or just a few indicators.

3.33 We summarise the assumptions, methodologies and our high-level approach to interpret results of the analyses and indicators that encompass the MCA report in the following sections. Our interpretation of results for individual projects is covered in the following section.

Market modelling analysis

3.34 The purpose of the market modelling analysis is to calculate the impact of a new interconnector or OHA on the market in GB and its connecting country. It quantifies a range of socio-economic and environmental factors, including impacts on consumers, producers and interconnectors SEW; decarbonisation; and security of supply.[47] These indicators form part of the MCA framework report.

3.35 To assess a project's performance under a wide range of outcomes, Arup have analysed the impacts of each project under a set of three scenarios, using two different modelling approaches as described below.

Modelling approaches

3.36 To assess project impacts under different levels of interconnection, and to understand the impacts which are attributable to a single Window 3 or OHA project under various market conditions, Arup undertook its assessment using the FA and MA approaches described below. This is in line with the methodology used for Windows 1 and 2 and is broadly equivalent to the TOOT (Take One Out at a Time) and PINT (Put One in at a Time) methodologies used by ENTSO-E for European-level studies.

- **First Additional (FA) approach**: this approach assesses the impact of each project against a baseline of interconnectors, including those currently operational, under construction or under development with regulatory approval. It assumes the assessed project is the only new project to connect to GB and no other

[47] Unserved energy hours is a measure of the amount of customer demand that cannot be supplied within a region due to a shortage of generation, demand-side participation or interconnector capacity.

project is built beyond the connection date of the assessed project. This therefore represents an estimate where the interconnector landscape is most optimistic from the perspective of the assessed project, meaning that results for the assessed interconnector are not impacted by, nor do they impact, other Window 3 or OHA pilot projects.

- **Marginal Additional (MA) approach**: this approach assesses the impact of each project against the baseline of interconnectors, including those currently operational, under construction or under development with regulatory approval, as well as all the other Window 3 and OHA applicant projects. This represents an estimate where the interconnector landscape is the most pessimistic from the perspective of the assessed project as it assumes all other projects in the window are constructed.

Scenarios

3.37 To assess projects under different market conditions, we confirmed the approach of using FES 2022 as the modelling scenarios.[48] We deem it important that the underlying scenarios were based on publicly available information to ensure the transparency, auditability, and replicability of Arup's analysis, as well as ensuring analytical compatibility with NGESO's system impacts analysis and other comparable analyses used elsewhere.

3.38 The FES 2022 represent credible decarbonisation pathways for the future of energy between now and 2050. Each scenario, detailed below, considers how much energy we would need and where it would come from:

- **Leading the Way (LW):** describes the fastest credible decarbonisation journey achieved through a combination of consumer-led and system-led solutions. This scenario includes high levels of cross-border capacity between GB and connected countries.
- **Consumer Transformation (CT):** this pathway reaches net zero by 2050 driven by consumer-led solutions. It includes lower levels of cross-border capacity than LW.

[48] For more information on the FES scenarios, please see NGESO's report: Future Energy Scenarios | ESO (nationalgrideso.com)

- **Falling Short (FS):** represents the slowest credible speed of decarbonisation and does not reach net zero by 2050. It includes relatively low levels of cross-border capacity.

Ofgem's considerations on market modelling results

3.39 We outline below our main considerations when interpreting the market modelling report:

- While Arup have provided us with results for the three scenarios and two approaches outlined above, in reaching our decision, **we have opted to focus our attention on the MA results across all three scenarios**. We have chosen to follow this approach because we consider that the MA approach depicts a more probable view of the world than the FA approach. The FA approach assumes that only one additional cross-border project will be built in GB to 2050 while the MA approach assumes that all the candidate Window 3 interconnectors and OHA pilot projects will be built in GB by the same date. Whilst not all projects might be successful in this application window, considering the expected increase in electricity demand and the deployment of more RES capacity required to meet net zero, it is reasonable to assume that additional assets such as interconnectors or OHA projects will be built in response to the needs of an increasingly electrified system.
- Arup's analysis is based on day ahead trading and does not account for the impacts of intraday trading. Although we said we were going to calculate the impacts of intraday trading in our modelling workshops, we have concluded that intraday trading would likely only result in marginal changes to the analysis compared to the practical burden of including this analysis. The reasons for this conclusion are further explored in Arup's market modelling report.
- For completeness, Arup have assessed the impact of a project in both GB and the connecting country. Ofgem is aware of the projected impacts of the projects in connecting jurisdictions. However, for our decision making, **Ofgem only considers the impact on GB**, as a cap and floor regime is underpinned by GB consumers.
- It should be noted that a positive result in the market modelling analysis does not overrule or outweigh the deliverability or system operability assessment. A project rated green in the market modelling may still not pass the IPA overall if there are serious concerns with its ability to deliver prior to the end of 2032 or with its impact on constraint costs.

System impacts

3.40 This section summarises the modelling approach undertaken by NGESO to produce the system impact analysis, and how this approach has been factored into Ofgem's decision making. The report is published alongside this consultation together with further details of the methodology, assumptions and results.

3.41 The purpose of the NGESO analysis is to calculate the impact of a new interconnector or OHA on GB's electricity system. It quantifies the following indicators, which feed into our MCA framework report:

3.42 **Constraint costs (balancing market impacts):** this quantifies the impact of an interconnector on constraint costs for GB, managed by the NGESO through the Balancing Mechanism.

1) **System operability:** This assesses the potential savings that an interconnector may provide to the grid through the provision of ancillary services. The services considered are:
    - **Frequency response** – the potential impact of the projects on system frequency.
    - **Reactive power** – the potential impact of the projects on system voltage.
    - **Restoration –** the potential impact of the projects on restoring power to the system in the unlikely event of a power outage.
2) **Avoided Renewable Energy Supply (RES) curtailment:** This is an assessment of the level of RES curtailment that would be avoided due to the addition of an interconnector or OHA.

3.43 As part of the submission material for Window 3, Ofgem required developers to detail any alignment with Grid Code 0137: Grid Forming Capability (GC0137). This aims to enhance the capability of conventional power electronic converter plant (e.g. wind farms, HVDC interconnectors and solar parks), so that the plant responds more like a traditional synchronous plant and is able to offer an additional grid stability service. The NGESO analysis was based on the assumption of projects conforming to GC0137 and participating in system operability services as applicants stated in their submissions.

Modelling methodology

3.44 To assess a project's performance under a wide range of outcomes, NGESO, in line with Arup's market modelling approach, analysed the impacts of each project under the same three scenarios and two modelling approaches. This means that NGESO assessed projects as follows:

- To provide a theoretical upper and lower limit of constraint costs and system operability benefits, NGESO used both an FA and MA approach. We note that, in general, for constraint costs, the MA results represent the lowest possible estimation of a project's attributable costs, and the FA the highest. This occurs because, in the MA approach, the inclusion of all the other Window 3 and OHA pilot projects reduces the impact of any one interconnector on constraint costs.
- To assess impacts of projects under different market conditions, NGESO used LW, CT, FS scenarios from FES 2022, following the same approach as Arup for the interconnector baseline.
- NGESO used the HND1/ NOA 2021/22 Refresh for assumptions of the optimal network.[49]

3.45 This analysis models the years from 2027 to 2042, using 2013 as the base weather year. NGESO can only model as far as 2042 as this is the last year in FES22 that provides a detailed zonal supply demand match. Without this, constraint cost analysis cannot be undertaken. This is an unavoidable practical constraint.

Ofgem's considerations on system impact analysis results

3.46 There are five aspects to the constraint cost (balancing market impacts) analysis that we have considered:

A. The network reinforcements already factored into the background network topography by NGESO to accommodate Window 3 projects as a result of project connection agreements;

[49] The Holistic Network Design (HND) gives a recommended offshore and onshore design for a 2030 electricity network that facilitates the Government's ambition for 50GW of offshore wind by 2030. The Network Options Assessment (NOA) 2021/22 Refresh is an update to the NOA 2021/22, published in January 2022. This integrates the HND's offshore network and confirms the wider onshore network requirements.

B. The remaining costs that continue, despite these mitigations in A and signal a need for further reinforcement (this is NGESO's analysis);

C. The additional network reinforcements that would be required to mitigate these remaining constraint costs (the costs of which we expect in general terms to be less than NGESO's analysis in B);

D. The time it would take to complete the signalled reinforcements in C; and

E. The residual constraint costs that would still remain even after the signalled reinforcements in C have been completed.

3.47 NGESO has explained to Ofgem that system impacts from all applicant projects have been factored in when running the HND1/ NOA 2021/22 Refresh and previous network design exercises based on the information contained in their connection agreements. This suggests that the addition of the applicant projects to previous network design exercises would have already triggered some reinforcement works for the system. We note that any costs that may arise from these reinforcement activities would need to be covered by consumers. We are unable to quantify the costs of these specific works from the data provided by NGESO to date.

3.48 We note NGESO's clarification that the constraint costs presented in its analysis are a view of future constraint costs and are sensitive to the assumptions used. The estimated constraint costs calculated in NGESO's analysis across the system provide a signal for the need for further network reinforcements or non-network solutions. We are concerned by the high level of these costs, especially for projects connecting in southern areas of the country. We are additionally concerned that such high costs are still present in NGESO's analysis even though Window 3 and OHA pilot projects are assumed to be in the assessed network background as stated above.

3.49 In subsequent network planning processes, NGESO will likely identify the optimal selection of additional network mitigations that would deliver economic benefit, whilst considering the impact on community, the environment and system operability. NGESO has also clarified through its report that the cost of reinforcing the network would be expected to be lower than the additional constraint costs shown in the report, but estimating the required reinforcement costs to mitigate the additional constraint costs attributable to the Window 3 and OHA projects is not possible at this stage, and each reinforcement is unique in terms of cost, network capability and timing.

3.50 Network reinforcements can take time, especially if they involve new onshore transmission lines and substations. The planning and consenting process may take many years to resolve and it is possible that new interconnectors or OHAs may be operational before the complete suite of onshore mitigating network reinforcements is completed.

3.51 We note that even after these reinforcement works are carried out, some remaining constraint costs would likely still be attributable to the assessed projects. We do not have estimates of these residual constraint costs, this data is not currently available for each project.

3.52 The MA approach is the basis of Ofgem's decision making as it presents a more probable picture of the interconnector landscape in comparison to the FA approach. This is in line with our considerations for the market modelling results.

3.53 Prior to undertaking our analysis, we indicated our intention to quantify the Window 3 project revenues from the provision of ancillary services.[50] However, after undertaking the analysis, Ofgem decided not to proceed with their quantification given the limited impacts those would have had on final results. Instead, we decided to factor them into our assessment in a qualitative manner. We note that the results provided by the NGESO for the system operability indicators are the potential savings that an interconnector or OHA may provide to the grid through the provision of ancillary services. This is not to the same as the revenues that projects could make out of the provision of those services. We have considered the results from NGESO's analysis on system operability as an indicator of the scale of ancillary services revenues.

Limitations of quantitative modelling

3.54 Following the conclusions of the ICPR, we endeavoured to incorporate as wide a range of interconnector impacts as possible to our quantified assessment of projects. Further, in the interest of transparency, we adjusted our approach and consulted developers on our key methodologies and assumptions prior to undertaking the different analyses that make up each part of the MCA framework. However, it is important to stress that any modelling exercise has limitations and necessarily makes simplifications through its various assumptions. When reaching our decision, we need to find the right balance between the information that is

[50] These are services that an interconnector or OHA may provide to the grid to balance the system such as the provision of frequency response, restoration, or reactive power services.

available to us and the uncertainty that surrounds this information. We outline below some key considerations for both the market modelling and the system impact analysis:

Modelling assumptions

3.55 Both analyses use FES 2022 which was the most up to date data possible at the time of undertaking the analysis from early 2023. It would not have been feasible to use FES 2023 data for this analysis, as the network reinforcement requirements would only have been available from early 2024, and thus NGESO would have been unable to determine the system impacts of new projects prior to the availability of this data. To ensure the alignment of analysis, both Arup and NGESO used FES 2022.

3.56 We note that during our modelling workshops, we indicated our intention to set the baseline for EU interconnectors by including all projects built and under construction and those with regulatory approval. However, during the modelling period, we instead decided to use the FES EU interconnector baseline. We followed this approach to align Arup's and NGESO's assumptions. We note that NGESO's FES scenarios are publicly consulted upon, and we have made available the underlying data for EU interconnector baseline.

3.57 We also note that both analyses use a different approach to weather years in their calculation. Arup uses three weather years (1990, 2007, 2010) to obtain an average of the results, whereas NGESO uses only on year (2013).

3.58 Using the FES 2022 and its EU market assumptions for our modelling is a choice that is analytically robust and transparent. However, we recognise that there are challenges owing to the practicalities of collecting data from different European sources and data on GB by NGESO. For example, to create the FES 2022, NGESO has to draw from ENTSO-E data conducted in 2020.

3.59 We sought to align assumptions as much as possible for both reports. However, given unavoidable differences such as the modelling tools used, the approach to modelling spot years after 2042 and the use of different weather years, Arup's and NGESO's results are not directly comparable. Therefore, we consider results from both reports as standalone indicators. It is important to note however, that the underlying trends in the results, such as flows and wholesale prices, from both modelling exercises, broadly align. This gives us confidence that although both modelling results are not directly comparable, they are robust and internally consistent.

Security of supply impacts

3.60 Security of supply impacts are characterised in the analysis only by 1) the project's contribution to reducing unserved energy hours in GB, and 2) the project's contribution through providing ancillary services. The analysis does not account for any other impacts that could come under the definition of security of supply.

Interactions between projects

3.61 Both modelling exercises use the FA and MA approach to understand a project's performance on its own or against all other projects. There is no guarantee that all projects will be accepted for a cap and floor regime, and removal of projects is likely to lead to differing results than those provided by the individual MA results for each project. To have an exact estimate of the combination of successful projects of our IPA, we would need to model all possible permutations of projects, which is impractical. The range provided by the FA-MA results already encompasses these permutations so we could expect that any combination of successful W3 and OHA pilot projects would fall within that range.

Wider market reforms

3.62 As referred to in the strategic case for interconnectors section, the analysis does not take into account the potential effects of locational pricing. This is due to the high uncertainty over the likelihood and timing of implementation of locational pricing, and indeed uncertainty over the nature of any locational pricing regime itself, which outweighed the practical burden of including this market reform in the analysis.

Use of confidential information

3.63 The analysis conducted by NGESO is derived from market sensitive data that cannot be publicly disclosed. However, NGESO have provided information to enable interpretation of their analysis and understanding of their conclusions and have provided higher transparency than in previous windows. Ofgem consider that NGESO possess the most appropriate expertise to model constraint costs, and is best placed to conduct this analysis as GB's System Operator.

Onshore costs

3.64 Part of the calculation of costs for the market modelling and MCA is the costs of onshore grid reinforcement ('onshore costs') to accommodate a given project's connection point. The stated intention prior to our analysis was for Arup to extract these costs from the submitted CIONs for each project and provide a RAG rating in the MCA for onshore costs. While assessing project submissions, Ofgem concluded that the CIONs are all materially out of date, as they were conducted against a 2018 or earlier generation landscape which predates the HND. Therefore, in addition to the discounting of CION data from the 'justification of connection location' criterion in the maturity assessment, Ofgem have not included the onshore costs within the MCA framework, as including these figures would have impacted the quality of the assessment. Throughout the consultation period Ofgem will continue to engage with NGESO to source up-to-date onshore costs for each Window 3 project.

4. The IPA for Window 3

Section summary

On the basis of the analysis from the three distinct assessment areas of the IPA - the maturity and deliverability assessment, market modelling, and system impacts – **we are minded to grant a cap and floor regime to the Tarchon project to Germany.** Our modelling indicates the project would provide a total welfare benefit to GB, and the project has demonstrated that it is mature and likely to connect prior to the end of 2032. We note the moderate constraint cost impact of the project.

This section provides our minded-to position on each project. Further detail on our analysis for each of the projects and how we reached this position is covered in subsequent sections dedicated to each project.

Questions

Q1. Do you agree with our minded-to positions on the seven projects considered in this consultation?

Q2. Is there any additional information that you think we should take into account when reaching our decision on the IPA of the projects?

Table 3: Summary of Window 3 project performance across the IPA

	Maturity	**Total SEW for GB £bn** (real 2022 GBP, NPV 3.5% discount rate)	**Total European carbon savings** (EU + GB & Norway) **mtCO2**	**Balancing market impacts (Constraint costs) £bn**	**System operability savings (frequency, voltage, restoration) £bn**
Aminth	Unclear Connection	£0.3 to £1	6.8 to 11.2	£0.1 to £1.0	£0.21
Aquind	Stated timeline unachievable	£1.3 to £4.3	16.3 to 25.4	£0.4 to £3.5	£0.28
Cronos	Grid connection in BE by 2032	£1 to £1.8	6.4 to 14.2	£1.3 to £4.6	£0.21
LirIC		-£0.6 to -£1	2.9 to 5.1	-£0.2 to £0.3	£0.09
MaresConnect		-£0.7 to -£1.1	3.1 to 5.4	£0.3 to £0.5	£0.08
NU-Link	Grid connection in NL by 2032	£0.6 to £1.3	6.3 to 12.2	£0 to £1.3	£0.14
Tarchon		£1.4 to £2.1	8 to 16.1	-£0.2 to £1.3	£0.18

Numbers expressed in ranges for total SEW, carbon savings and constraint costs show the range of results between all scenarios for the MA approach. The system operability column takes an average of the benefits across all the ancillary services listed. Each indicator shows the total result for the project over a 25-year period.

4.1 Overall, the results for Window 3 matches the high-level expectation stated in the ICPR that interconnectors operational from the 2030s onwards would be primarily exporting, and this feature has a range of associated impacts, all present in this analysis. As anticipated in the ICPR, most projects show a total welfare benefit to GB (as a sum of consumer, producer and interconnector welfare), with only two projects which are negative. The positive welfare impact of these projects is characterised primarily by producer welfare, as future interconnector flows become a route to export excess GB wind energy. However, this also means that most of the applicant interconnectors contribute to a rise in GB wholesale prices, leading to negative consumer welfare. Consumer welfare rises into the late 2030 and 2040s for some projects as they contribute to reducing unserved energy hours, allowing for imports to GB in times of system stress, and therefore enhancing security of supply. The welfare calculations account for indicative producer/consumer transfers such as CfD and cap and floor payments. Beyond CfDs there are no current regulatory mechanisms for sharing the strong benefit for producers from these projects with consumers.

4.2 Market modelling indicators outside of welfare- decarbonisation and security of supply- were positive among all projects and have been considered alongside welfare projections. The decarbonisation benefits vary across projects, all contribute to overall carbon savings across Europe, however, many projects would increase emissions in GB specifically in some scenarios.

4.3 The system impacts analysis is less favourable, and often shows very high constraint costs, up to £4.6bn for some projects. The constraint costs often overshadow the system operability benefits of the interconnectors, such as the more modest benefit from interconnectors providing ancillary services, or the savings from avoided wind curtailment. When assessed alongside the market modelling, this shows that Window 3 projects often are valuable for GB as a whole, predominantly as exporter interconnectors for excess wind energy. However, in doing so, the projects incur high constraint costs across various boundaries across the GB network, and in the local areas to which they are connected, implying they are not in the most suitable locations in GB to maximise overall value. We are concerned that such high constraint costs are present in NGESO’s analysis despite Window 3 and OHA pilot projects being assumed to be in the network background for this analysis, and that the analysis already includes works accounted for in the CION analysis and connection agreements of the projects.

4.4 Our analysis suggests that there are relatively few projects that perform well across the board. For most projects, performance is inversely correlated between criteria – strong economic performance can be at the expense of deliverability (signalling a project that is theoretically beneficial but looks unlikely to overcome development challenges); or positive market impacts are offset by constraints in moving energy around the system.

4.5 The wholesale price impact and therefore consumer welfare impact should not be viewed in isolation. In the modelling, we expect Window 3 interconnectors to contribute to a rise in wholesale prices. However, in the 2030s and 2040s, we expect wholesale prices to be lower overall for GB compared to today, owing to the decarbonisation of our energy system and the decreasing reliance on international gas markets. Additionally, in our modelling we can only quantify the wholesale price impact of projects individually.

4.6 As we have previously stated, we have chosen not to weight results from any particular scenario or indicator in a mechanistic manner. This is to ensure sufficient discretion in reaching a final decision on whether to award a cap and floor regime in principle with regard to the Application Guidance for Window 3 and GEMA's principal objective of protecting the interests of existing and future consumers.

Our minded-to position on the IPA of Aminth

4.7 We are minded to not offer a cap and floor regime to Aminth. The main reason for this is that the project did not provide evidence to Ofgem's satisfaction to demonstrate that it is likely to connect prior to the end of 2032.

4.8 Aminth plans to connect to the Danish North Sea Energy Island. Construction of the island has been paused owing to the high costs of the current design, and a recent published statement from the Danish Ministry for Climate, Energy and Utilities states that the first stage of the island is expected to be completed by 2033, and the full island by 2040.[51] We understand Aminth cannot secure a connection agreement to the island until the plans for the construction of the island are secured. There is no stated alternative plan for grid connection to Denmark in the application. Aminth have not provided Ofgem with sufficient evidence in light of the material change in their circumstances to give us sufficient confidence that connection to the island prior to the end of 2032 is likely.

[51] The concept of Energy Island North Sea will be examined thoroughly (kefm.dk)

Our minded-to position on the IPA of AQUIND

4.9 We are minded to not offer a cap and floor regime to AQUIND. The main reason for this is the very high constraint cost impact of the project. The project demonstrates elsewhere in the analysis that consumers would incur significant costs, shown through negative consumer welfare in the majority of scenarios in the market modelling, and so we are particularly concerned about the additional costs to consumers that the constraint impact would suggest.

Our minded-to position on the IPA of Cronos

4.10 We are minded to not offer a cap and floor regime to Cronos. This is based upon the very high constraint cost impact of the project, and because the project did not provide evidence to Ofgem's satisfaction to demonstrate that it is likely to connect prior to the end of 2032.

4.11 Cronos's constraint costs are very high. The project demonstrates elsewhere in the analysis that consumers would incur significant costs, shown through negative consumer welfare in all scenarios of the market modelling, and so we are particularly concerned about the additional costs to consumers that the constraint impact would suggest.

4.12 Cronos is currently engaging with Elia to obtain a grid connection in Belgium to connect in the year 2032 at the earliest, to account for network reinforcements in Belgium which would prevent the project from connecting at an earlier date. Stages to the project's development in Belgium have already been delayed owing to the project's status as the first independently owned interconnector in Belgium. The information submitted in Cronos' application does not provide us with sufficient confidence that material delays will not occur in the project's development, nor that connection to Belgium prior to the end of 2032 is likely.

Our minded-to position on the IPA of LirIC

4.13 We are minded to not offer a cap and floor regime to LirIC, based upon the negative total welfare impact on GB of the project. In the market modelling, LirIC has a negative total welfare impact on GB in both the first additional and marginal additional cases. Wider benefits that were assessed in the modelling, such as the project's positive decarbonisation and security of supply impacts, are modest by comparison, and do not justify approving the project, in light of the project's negative welfare impact.

Our minded-to position on the IPA of MaresConnect

4.14 We are minded to not offer a cap and floor regime to MaresConnect, based upon the negative total welfare impact on GB of the project. In the market modelling, MaresConnect has a negative total welfare impact on GB in both the first additional and marginal additional cases. Wider benefits that were assessed in the modelling, such as the project’s positive decarbonisation and security of supply impacts, are modest by comparison, and do not justify approving the project, in light of the project’s negative welfare impact.

Our minded-to position on the IPA of NU-Link

4.15 We are minded to not offer a cap and floor regime to NU-Link. The main reason for this is that the project did not provide evidence to Ofgem’s satisfaction to demonstrate that it is likely to connect prior to the end of 2032.

4.16 NU-Link is currently engaging with the Dutch system operator, TenneT, to obtain a grid connection for the project prior to the end of 2032. TenneT determined after the developer’s submission that there would be no unrestricted capacity available on the grid in the Netherlands for a connection in 2031 as NU-Link had requested.

4.17 When prompted to respond to this material change in circumstances, NU-Link explained it was challenging TenneT’s position and that it has submitted an alternative application to TenneT for connection at a different substation.

4.18 Ofgem has not been provided with sufficient information from the developer to clarify how feasible it is for unrestricted capacity to become available on the Dutch grid before the end of 2032. NU-Link has unresolved obstacles in obtaining its grid connection in the Netherlands, and TenneT and the developer are not aligned on milestones, timelines for connection, and understanding of the network planning process. The evidence submitted by the developer does not assure Ofgem that a connection prior to the end of 2032 is likely for the NU-Link project.

Our minded-to position on the IPA of Tarchon

4.19 We are minded to offer a cap and floor regime to Tarchon, as the project demonstrates a total welfare benefit to GB, and its developer has provided evidence that satisfies Ofgem that the project is mature and is likely to connect prior to the end of 2032. The project does lead to an increase in constraint costs. However, the upper boundary of the possible constraint costs is low enough for the consumer risk to be manageable. The project overall is in the interest of GB consumers.

5. Aminth

Maturity and deliverability assessment

Stage	Requirement	RAG rating
Eligibility to be considered for IPA	A GB connection agreement for connection prior to the end of 2032	
	Licence application made to Ofgem	
IPA	Project Overview	
	Qualitative assessment of risks and dependencies	
	Hard to monetise impacts	
	Project plans	
	Plans for grid connection in connecting country	
	Plans for obtaining regulatory approval in connecting country	
	Justification of chosen connection location, capacity and design	
	System operability (Grid Code GC0137)	
	Financing strategy	
	Supply chain plans	

Qualitative assessment of risks and dependencies

5.1 Aminth's submission includes a high-level description of risks in the development and construction phase of an interconnector, without relating them to the project itself. An amber rating was given as the developer did not prioritise risks, explain the impact or consequences of a risk occurring to the project specifically, or provide detail of mitigation measures.

Hard to monetise impacts

5.2 Aminth's submission provided qualitative analysis of the potential impact of the project on the environment and local community, scoring green ratings in Arup's MCA. Ofgem considers this analysis to be representative of the developer having due consideration of the project's potential impacts on the local area. However, the submission did not contain an assessment of noise impacts, and consequently was given a red rating against this indicator by Arup. Ofgem tolerate this omission at this stage but would expect the developer to undertake a more thorough assessment should the project receive a cap and floor in principle.

5.3 The overall RAG rating for the HtM indicator is assigned by Ofgem based on Arup's RAG ratings for the individual HtM components and Ofgem's further consideration. Taking into account the above, we have given Aminth an amber rating overall for this criterion.

Project Plans

5.4 Aminth states it plans to connect on 30 November 2031, with a construction timeline of 4 years. The project has submitted a detailed milestone plan that is realistic and well-informed, demonstrating the developer is aware of the steps required of them. We note that there are obstacles faced by the project for obtaining a grid connection in Denmark, noted in the section below, which are not accounted for here. As noted in the risks and dependencies section, more detail on mitigation and contingency strategies would be beneficial.

Plans for grid connection in connecting country

5.5 To become operational prior to the end of 2032, in practice, Aminth would need a connection agreement prior to the end of 2032 in both GB and Denmark. In situations where the two sides of the interconnector have differing connection agreement dates, the later date will take precedent. Therefore, Ofgem uses the information and evidence submitted by the applicant in relation to "plans for grid connection in the connecting country" to determine an applicant's ability to meet the operation start date prior to the end of 2032.

5.6 Aminth's application stated it would connect to the Danish North Sea Energy Island and provided a holding letter from Energinet, the Danish TSO, acknowledging conversations had been held with the project since 2021, however, with no statement of commitment to the project.

5.7 In the application, there were no stated alternative connection points or a contingency plan to connect to the Danish shore should connection to the island not be a possibility.

5.8 Following project submission, in June 2023, the Danish Ministry of Energy, Climate and Utilities announced its intention to pause the development of the North Sea Energy Island, on grounds of high cost and lack of profitability in its current design. This delay represents a material change to Aminth's circumstances. The timelines for construction of the island and the tendering of connections remain uncertain, with a recent published statement noting the first phase is expected to be completed by 2033, and the second phase by 2040.[52]

5.9 When prompted to respond to this material change, Aminth did not provide sufficient evidence to assure Ofgem that it would be possible for the project to connect to the island prior to the end of 2032.

Plans for obtaining regulatory approval in the connecting country

5.10 In Aminth's application, the developer provides an explanation of the Danish regulatory regime and the decision-making scope of each authority, indicating the developer's knowledge of the milestones required to obtain regulatory approval in Denmark. The developer provides early and high-level engagement with the Danish authorities.

5.11 In its application, the developer stated that it was seeking the status of the Projects of Mutual Interest (PMI) under the recast TEN-E Regulation 2022[53] for Aminth.

5.12 A PMI is a new category of projects created under the revised TEN-E Regulation 2022. PMIs are key cross-border energy infrastructure projects between the EU and non-EU countries, which contribute to the energy and climate policy objectives of the Union.[54] Projects with PMI status will be included in the Union list, established pursuant to the TEN-E Regulation 2022, and can benefit from accelerated permitting and consenting procedures as well as from the regulatory support at the national level.

5.13 The developer, in August 2023, provided Ofgem with a letter from the Danish Ministry of Energy and Climate, which requested that Ofgem wait for the final version of the Union list before the Ministry could consider Aminth's regulatory approval in Denmark in further detail.

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[52] The concept of Energy Island North Sea will be examined thoroughly (kefm.dk)

[53] Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure, amending Regulations (EC) No 715/2009, (EU) 2019/942 and (EU) 2019/943 and Directives 2009/73/EC and (EU) 2019/944, and repealing Regulation (EU) No 347/2013; EUR-Lex - 32022R0869 - EN - EUR-Lex (europa.eu)

[54] More information about the PMI projects can be found on the European Commission's website: new list of EU energy Projects of Common and Mutual Interest (europa.eu)

5.14 "*The first Union list of projects of common interest and projects of mutual interest*" was adopted by the Commission on 28 November 2023.[55] Aminth does not appear on the Union list.

5.15 While we acknowledge that the Commission's delegated regulation establishing this first Union list has not yet entered into force, we note that at this stage it is impossible to add any individual projects to the Union list. The Union list has been transmitted to the European Parliament and Council, which can only approve or reject the whole Union list.[56]

5.16 Overall, Ofgem has not been provided with sufficient evidence by the developer of Aminth to demonstrate that the project is likely to receive regulatory approval in Denmark in time to become operational by the end of 2032.

Justification of chosen connection location, capacity and design

5.17 The justification for the chosen connection points on both ends of the cable is very limited in Aminth's application. There is no evidence of optioneering for the landing site, onshore cable or converter station, or thorough engagement with the transmission system operators on either side of the cable to consider options. There is only a high-level consideration to minimise the interconnector costs through the choices made.

5.18 The technical design for the project within the application is sound however lacking in detail and justification, which impacts Ofgem's understanding of the project's ability to meet availability requirements.

System operability (GC0137)

[55] The link to the Commission's delegated regulation establishing the *first Union list of projects of common interest and projects of mutual interest* [EUR-Lex - C(2023)7930 - EN - EUR-Lex (europa.eu)]. The link to the *first Union list of projects of common interest and projects of mutual interest:* [Annex on the first Union list of Projects of Common and Mutual Interest - European Commission (europa.eu)]

[56] From the adoption of the Union list, the European Parliament and Council have two months to accept or reject the Union list. The Parliament and the Council cannot introduce amendments to the Union list. The scrutiny period of two months may be extended by additional two months upon either co-legislator's request (Article 20(6) of the TEN-E Regulation 2022). If no objections are raised by the Parliament or the Council, the Commission's delegated regulation establishing the Union list will enter into force on the twentieth day following that of its publication in the Official Journal of the European Union.

5.19 The developer confirms through Aminth's application that the project would provide additional ancillary services through Grid Forming Capability. The benefits of this are not captured in the application but rather in NGESO's analysis.

Financing strategy

5.20 Amith's financing strategy is based on a planned project finance[57] structure. The target gearing level is approximately 80%. The financing plan is supported by non-binding letters from a bank which has structured and arranged project financing for interconnector projects in GB and from an institutional lender/investor.

Supply chain plans

5.21 Aminth's application demonstrates initial work has been undertaken to engage with potential suppliers and the developer is aware of the steps required to secure a cable contract, outlining in general terms the main cabling types available in Europe and how the procurement process functions. However the evidence is very high level, and the information provided does not relate back to the Aminth project specifically.

Market modelling analysis

5.22 Aminth has been modelled connecting to the proposed Danish North Sea Energy Island. The modelling assumes an Offshore Bidding Zone market arrangement on the energy island, and a 1.4GW connection from the Danish island to the Danish shore.[58]

5.23 The following results refer to the MA approach only. This is because the MA approach is the basis of Ofgem's decision making as it presents the more realistic picture of the interconnector landscape.

Welfare

5.24 The modelling indicates Aminth is projected to deliver a total welfare benefit to GB in all scenarios, driven by strong producer SEW. However, this includes negative

[57] Project finance is raised based primarily on the creditworthiness and investability of the project rather than being financed as part of the financing of a large established corporate group. Typically, in project finance structures there is limited or no recourse by lenders to the shareholders beyond the shareholders' equity and any other negotiated support commitments. Project finance structures also usually have higher gearing than corporate finance structures.

[58] Aminth's configuration, which mirrors that of an NSI, was reflected in the modelling. However, the project has been otherwise assessed in Window 3 as per its submission.

consumer SEW impacts for GB in all scenarios due to the anticipated predominant export flows to Denmark causing an increase in wholesale prices.

Revenue Expectations

5.25 The modelling suggests that Aminth would not depend on floor payments throughout its lifetime, after capacity market revenue is considered. Instead, Aminth is expected to make some marginal cap payments around 2050 in CT and FS. Ofgem is satisfied that Aminth would not be expected to be a detriment to consumers in terms of requiring excessive floor top-ups.

Decarbonisation

5.26 Arup's market report suggests that Aminth would contribute to a significant reduction in emissions across Europe, including GB, yet a net increase in CO2 emissions in GB only in FS and CT. This trend is a consequence of Aminth's expected predominant export usage which leads to higher wholesale prices in GB and the dispatch of more expensive gas-fuelled generation. A cross border approach to decarbonisation is important for progressing climate change ambitions.

Security of supply

5.27 Aminth is expected to be beneficial to security of supply in LW by reducing the number of USE hours in GB, with consequent savings of £371.5m. For CT and FS, Aminth is anticipated to have a neutral impact due to no USE hours being expected before or after Aminth's connection.

System Impacts analysis

5.28 NGESO has undertaken analysis on the system operability benefits and constraint cost impact of Aminth. Further information can also be found in NGESO's report published alongside this document.

Constraint costs (balancing market impacts)

5.29 The connection of Aminth is anticipated to result in an increase in constraint costs of between £0.1 to £0.9bn, comparing the lowest (FS) and highest (CT) scenarios of the MA approach.

5.30 The analysis suggests that Aminth increases constraint costs on several northern boundaries, but relieves congestion on certain midland boundaries in the early years. This shows that Aminth's proposed GB connection location in the Midlands is beneficial in reducing constraints in the area near which it connects in the early years of operation. However, these constraint savings are not large enough to negate the constraint costs incurred by Aminth across the 25 years.

Frequency response

5.31 NGESO's analysis shows that Aminth could be expected to facilitate frequency response savings of between approximately £100m-£110m in the MA approach across the 25 years. There is minimal variation across the three scenarios, with LW representing the lowest impact and FS the highest. Ofgem recognises that the frequency response landscape will change considerably over the coming decades and, therefore, there is inherent uncertainty in quantifying the benefits of Aminth in providing frequency response services. However, reform of NGESO's ancillary service and balancing markets are designed to make markets more efficient, accessible and liquid which may potentially lead to even greater levels of participation of Aminth than that assumed in this analysis.

Reactive power

5.32 The modelling suggests that Aminth is anticipated to lead to reactive power savings of approximately £110m in the MA approach across the 25 years. This figure is constant across all scenarios, and there is minimal to no variation across the MA approach, due to the little variation in reactive power benefit from an interconnector whether it is importing, exporting, or float.[59] Ofgem notes that this figure likely represents an upper estimate of the potential savings, given that the analysis assumes that all reactive power benefits that could be provided by Aminth are required, which may not be the case. Nonetheless, Ofgem is satisfied with these projected savings as suggested by the analysis.

Restoration

5.33 According to the analysis by NGESO, Aminth could be expected to facilitate savings for restoration services of between approximately £35m and £43m in the MA approach across the 25 years, with the potential savings being greatest under LW, followed by CT and FS. Ofgem note the uncertainty of this analysis owed to the difficulty in forecasting future cost assumptions and also due to the fundamental changes anticipated in the restoration services landscape over the coming decades.

Avoided RES curtailment

[59] Float refers to the time at which an interconnector is neither importing nor exporting.

5.34 The NGESO analysis suggests that the addition of Aminth is estimated to result in avoided RES curtailment of between approximately 25TWh and 30TWh for the 25-year life of the project under the MA approach. These savings are lowest in the LW scenario and highest in the CT scenario. This is because CT has high levels of renewable generation combined with low hydrogen production from electrolysis which leads to the highest levels of RES curtailment across the three scenarios, providing Aminth with the greatest opportunity to reduce this curtailment. Ofgem recognises the uncertainty around forecasting potential system operability benefits over a 25-year time horizon, but is satisfied with the projected potential of Aminth to contribute to avoiding RES curtailment.

6. AQUIND

Maturity and deliverability assessment

Stage	Requirement	RAG rating
Eligibility to be considered for IPA	A GB connection agreement for connection prior to the end of 2032	
	Licence application made to Ofgem	
IPA	Project Overview	
	Qualitative assessment of risks and dependencies	
	Hard to monetise impacts	
	Project plans	
	Plans for grid connection in connecting country	
	Plans for obtaining regulatory approval in connecting country	
	Justification of chosen connection location, capacity and design	
	System operability (GC0137)	
	Financing strategy	
	Supply chain plans	

Qualitative assessment of risks and dependencies

6.1 AQUIND's risk assessment submitted in its application is limited. The developer details risks resulting from regulatory and policy changes that could affect the interconnector's revenues once operational, and also briefly discusses supply chain risk to source cable materials. However, the developer's identification and assessment of risks present at development and pre-construction stage is limited.

6.2 A key dependency identified by AQUIND is obtaining a Development Consent Order (DCO) to begin construction of the interconnector. It has previously been refused and a decision is pending following a successful judicial review by AQUIND. We note that currently it is not known when the Secretary of State for Energy Security and Net Zero, who is responsible for the re-determination of AQUIND's application, will take the decision and there is no statutory deadline for such a decision. In addition, we note, based on the public documents on the National Infrastructure Planning website, that the Ministry of Defence (MoD) has been examining the project and has been granted additional time so that it can prepare substantive representations on concerns regarding the project.60

6.3 We acknowledge that the MoD request for additional time to prepare its representations on the project is a recent development from January 2024, and AQUIND's developer could not have reasonably foreseen this in preparing a Window 3 application. However, while the developer, in its Window 3 application, identifies the risk in obtaining a DCO, it would be beneficial for the developer to have explained contingency plans or mitigation strategies in greater detail, to assure Ofgem that the interconnector will not face further delays at the pre-construction stage.

Project Plans

6.4 AQUIND states in its application that the project will become operational by Q3 2027. Identified remaining milestones in the project's development to reach this date include securing regulatory approval in France and reaching final investment date in early 2024. AQUIND also state that Final Project Assessment material for the cap and floor regime will be submitted to Ofgem in early 2024. Construction is expected to last three years. Since the submission of AQUIND's application, in response to a request for further information, the developer confirmed that a connection in 2028 appears "more realistic" than 2027 as originally stated in the application. The developer suggests this delay is due to the extended timeline of Window 3 assessment.61

6.5 Ofgem considers that the stated timelines in the application are very unlikely to be achieved. Past experience of interconnector development shows that the remaining steps to AQUIND's development are those that are most vulnerable to delay for previous interconnectors. Nonetheless, connection prior to the end of 2032 remains feasible on the basis of the submitted project plan.

[60] The relevant webpage: AQUIND Interconnector | National Infrastructure Planning (planninginspectorate.gov.uk). The relevant letters issued by DESNZ: Secretary of State update on the AQUIND re-determination - 26 January 2024 (planninginspectorate.gov.uk) and AQUIND Mail Merge letter 'deadline for the Ministry of Defence to submit its representations'.pdf (planninginspectorate.gov.uk)

[61] AQUIND's original W3 application to Ofgem noted a 2027 connection date. However, following a response to further information request in October 2023, AQUIND note that operations in 2028 appear more realistic. This has been taken into account for the maturity and deliverability assessment, and for the interpretation of the modelling results, however as this notification to Ofgem arrived after the economic modelling and network analysis was completed, AQUIND has been modelled as connecting in 2027.

6.6 We also note that AQUIND has a connection agreement in GB at Lovedean, with non-firm capacity, until the earlier of non-attributable reinforcement works being completed in the area, or December 2030. While an interconnector is operating at non-firm capacity, NGESO reserves the right to curtail the interconnector or reduce its capacity to a specified number of MW. Were AQUIND to connect in 2027 or 2028, there is an operational risk that the interconnector may not operate at all or operate well under full capacity for the first few years, affecting the project's revenues, capability to deliver ancillary services to the grid, and constraint cost impact. Ofgem consider that connection by 2028 as stated by the developer would result in the interconnector not realising its full range of projected benefits. However, firm connection is projected before the end of 2032, and therefore the project remains suitably mature for the purposes of this assessment.

Hard to monetise impacts

6.7 AQUIND's submission material demonstrated a comprehensive analysis of hard to monetise impacts across all indicators, scoring green ratings in Arup's analysis on the basis of having provided sufficient information within the application. This includes analysis of a broad range of impacts, such as physical processes, socioeconomics, and traffic and transport.

6.8 Ofgem acknowledge the analysis provided by AQUIND. However, Ofgem is also aware of long-standing opposition faced by AQUIND amongst local community groups in GB. Further detail would have been beneficial in light of this to demonstrate an understanding of local community impacts that would occur prior to the construction of the project, alongside mitigation efforts.

6.9 The overall RAG rating for the HtM indicator is assigned by Ofgem drawing upon Arup's RAG ratings for the individual HtM components alongside Ofgem's further considerations. Taking into account the above, we have given AQUIND an amber rating for this criterion.

Plans for grid connection in the connecting country

6.10 AQUIND has a connection agreement in France at the Barnabos substation in Normandy, with some attributable reinforcement works required to accommodate the connection. We note that the connection deadline is expressed by reference to various milestones and circumstances rather than by a reference to a specific date.

Plans for obtaining regulatory approval in the connecting country

6.11 AQUIND's application states it will pursue a regulatory exemption in France. This regulatory path would exempt AQUIND from requiring joint ownership with the transmission owner in France, RTE. The application identifies the steps required to obtain approval. However, based on information contained in AQUIND's application and received in response to Ofgem's further request for information, engagement with the regulator CRE is very limited, and no steps have been implemented.

Justification of chosen connection location, capacity and design

6.12 The optioneering work conducted to determine a preferred connection location in GB is detailed and comprehensive, and it is clear that the developer has conducted necessary engagement with TSOs on both sides of the interconnector to consider the optimal connection location for the project.

System operability (GC1037)

6.13 The developer confirms through AQUIND's application that the project would provide additional ancillary services through Grid Forming Capability. The benefits of this are not captured in the application but rather in NGESO's analysis.

Financing strategy

6.14 AQUIND's financing strategy is based on a planned project finance structure. The target gearing level is to be above [redacted]. The financing plan is supported by non-binding letters from three infrastructure equity investors and from eight banks/institutional lenders. The developer has informed Ofgem of a further expression of interest from an equity investor since AQUIND's application.

Supply chain plans

6.15 AQUIND's application details extensive engagement with cable suppliers conducted between 2014 and 2019. The application demonstrates that the developer has been proactive and prepared in starting the tendering process for the cable. However, we are concerned this work may now be outdated given subsequent changes in the supply chain environment, and may not reflect current constraints or contracting approaches in the market.

Market modelling analysis

6.16 AQUIND has been modelled as a 2GW interconnector between GB and France, connecting in 2027 as per the original project submission.

Welfare

6.17 AQUIND has a positive total welfare impact in GB under all scenarios. It has significantly positive consumer welfare impact under the LW scenario only. This consumer welfare is driven by the fact that in LW, the project would be used to import electricity from France and also would contribute to a reduction in unserved energy hours in GB. Both of these also mean that AQUIND would be responsible for lowering wholesale prices in GB.

6.18 However, in other scenarios, the project is primarily used to export. The French energy system is characterised by high shares of nuclear generation presenting high short term marginal costs which determine the clearing price, and by comparison GB has much higher shares of RES generation with lower wholesale prices. This leads to the flows on AQUIND primarily exporting excess RES from GB to France.

Revenue Expectations

6.19 The modelling suggests that AQUIND would not depend on floor payments throughout its lifetime and instead be expected to provide cap payments to consumers throughout a large proportion of the modelled period. These high revenue predictions are due to the high anticipated price differentials between GB and France. Ofgem is satisfied that AQUIND would not be a detriment to consumers in terms of requiring excessive floor top-ups, and could provide benefit to consumers through cap payments.

Decarbonisation

6.20 AQUIND contributes to carbon savings in in both GB and France, and when accounting for Europe as a whole (EU, GB and Norway) by displacing thermal generation through its imports of RES capacity.

Security of supply

6.21 AQUIND's non-firm connection agreement has implications for how we interpret the market modelling results. As there is a risk that the interconnector will not operate at full capacity until 2030, project revenues and constraint costs for the years 2027-2030 may be lower than modelled.

System Impacts analysis

6.22 NGESO has undertaken analysis on the system operability and balancing market (constraint costs) impacts of AQUIND. Further information can also be found in the report by NGESO published alongside this document.

Constraint costs (balancing market impacts)

6.23 The connection of AQUIND is anticipated to result in an increase in constraint costs of between £0.4bn and £3.5bn, comparing the lowest (FS) and highest (LW) scenarios of the MA case.

6.24 AQUIND is projected to increase constraints costs on several northern, midland and southern boundaries, and relieve congestion on some southern boundaries. Despite the modelling indicating that AQUIND does show the potential to reduce constraint costs on some boundaries, particularly in 2031, this impact is not large enough to mitigate the substantial constraint costs on other parts of the network across the 25-year life of the project. Ofgem can infer from this information that AQUIND's proposed location on the south of England, alongside its expected predominant exporting behaviour, results in increased flows in typically constrained parts of the GB network and more balancing actions required to relieve constraints across various boundaries.

6.25 As noted in the overview of NGESO's methodology, if a project were to be approved for a cap and floor regime, grid reinforcement work would likely need to be undertaken by NGESO to alleviate the constraint impact of the interconnector on the system. We cannot be certain of the exact costs and timelines of grid reinforcement that are necessary to accommodate a specific interconnector at this time. AQUIND's constraint costs are considerably high in two out of three scenarios, with an upper boundary of £3.5bn in the MA approach. We can anticipate these substantial costs could trigger network reinforcements. NGESO and consumers would have to bear these costs until the works are complete, which is a timing yet undefined. To minimise the impact on the electricity system, we deem it appropriate to only consider projects for a cap and floor regime with low constraint costs or constraint savings, specifically considering the upper boundary of the range of costs which could be incurred. Based on the information we have available, AQUIND's constraint cost projections currently pose a significant risk for consumers.

Frequency response

6.26 The modelling shows that AQUIND could be expected to facilitate frequency response savings of between approximately £130mn-£160mn in the MA approach, with the largest potential savings deriving from the FS scenario, followed by LW and CT. Ofgem recognises that the frequency response landscape will change considerably over the coming decades and therefore there is inherent uncertainty in quantifying the benefits of AQUIND in providing frequency response services. However, reform of NGESO's ancillary service and balancing markets are designed to make markets more efficient, accessible and liquid which may potentially lead to even greater levels of participation of AQUIND than that assumed in this analysis.

Reactive Power

6.27 According to the analysis by NGESO, AQUIND is anticipated to lead to reactive power savings of between approximately £130-£140mn in the MA approach, with FS representing the highest potential savings. There is minimal variation between the FA and MA approaches, due to the little variation in reactive power benefit from an interconnector whether it is importing, exporting, or float. Ofgem notes that this figure likely represents an upper estimate of the potential savings, given that the analysis assumes that all reactive power benefits that could be provided by AQUIND are required, which may not be the case. Nonetheless, we are satisfied with these projected savings as suggested by the analysis.

Restoration

6.28 The modelling suggests that AQUIND could be expected to facilitate savings for restoration services of between approximately £40mn and £50mn for the 25-year life of the project in the MA approach, with the potential savings being greatest under LW, followed by CT and FS. We note the uncertainty of this analysis owed to the difficulty in forecasting future cost assumptions and also due to the fundamental changes anticipated in the restoration services landscape over the coming decades.

Avoided RES curtailment

6.29 NGESO's analysis suggests that the addition of AQUIND is estimated to result in between approximately 30TWh and 50TWh avoided RES curtailment for the 25-year life of the project under the FA approach. These savings are lower in the LW and FS scenario and highest in the CT scenario. This is because CT has high levels of renewable generation combined with low hydrogen production from electrolysis which leads to the highest levels of RES curtailment across the three scenarios, providing AQUIND with the greatest opportunity to reduce this curtailment. Ofgem is satisfied with the projected potential of AQUIND to contribute to avoiding RES curtailment.

7. Cronos

Maturity and deliverability assessment

Stage	Requirement	RAG rating
Eligibility to be considered for IPA	A GB connection agreement for connection prior to the end of 2032	
	Licence application made to Ofgem	
IPA	Project Overview	
	Qualitative assessment of risks and dependencies	
	Hard to monetise impacts	
	Project plans	
	Plans for grid connection in connecting country	
	Plans for obtaining regulatory approval in connecting country	
	Justification of chosen connection location, capacity and design	
	System operability (GC0137)	
	Financing strategy	
	Supply chain plans	

Qualitative assessment of risks and dependencies

7.1 Cronos's submission includes a high-level description of risks in the development and construction phase of an interconnector, without relating them to the project itself. An amber rating was given as the developer did not prioritise risks, explain the impact or consequences of a risk occurring to the project specifically, or provide detail of mitigation measures.

Hard to monetise impacts

7.2 Cronos' submission provided qualitative analysis of the potential impact of the project on the environment and local community. This was awarded green ratings in Arup's MCA. Ofgem considers the analysis as per Cronos' submission to be representative of the developer having due consideration of the project's potential impacts on the local area. However, the submission did not provide an assessment of noise impacts, and consequently was awarded a red rating against this indicator by Arup. Ofgem tolerate this omission at this stage but would expect the developer to undertake a more thorough assessment in the upcoming planning and development processes.

7.3 The overall RAG rating for the HtM indicator is assigned by Ofgem drawing upon Arup's RAG ratings for the individual HtM components alongside Ofgem's further considerations. Taking into account the above, Ofgem give Cronos an amber rating overall for this criterion.

Project Plans

7.4 Cronos states it plans to connect on 29 October 2029, with a construction timeline of three years. The developer submitted a detailed milestone plan that appears realistic and well-informed, demonstrating the developer is aware of the required steps. We note that a three year construction period may be vulnerable to delay, and additionally there are obstacles faced by the project for obtaining a grid connection in Belgium, noted in the section below, which are not accounted for here. As noted in the risks and dependencies section, more detail on mitigation and contingency strategies would be beneficial.

Plans for grid connection in the connecting country

7.5 To become operational prior to the end of 2032, in practice, Cronos would need a connection agreement prior to the end of 2032 in both GB and Belgium. In situations where the two sides of the interconnector have differing connection agreement dates, the later date will take precedent. Therefore, Ofgem uses the information and evidence submitted by the applicant in relation to "plans for grid connection in the connecting country" to determine an applicant's ability to meet the operation start date prior to the end of 2032.

7.6 At the point of IPA submission, Cronos had made initial steps with the Belgian TSO Elia to find a grid connection point in Belgium. Cronos noted an initial grid feasibility study was in progress.

7.7 The grid feasibility study was completed after the closure of the window and provisionally offers Cronos a connection date in Belgium that would sit between 2032-2035, due to necessary reinforcements being anticipated to be completed in 2032 at the earliest.

7.8 When asked to respond to this material change in the project's circumstances, Cronos state that under these circumstances it is possible for the project to reach operations prior to the end of 2032, and the developer confirmed it is pursuing a full connection agreement at either of the identified connection points in the feasibility study.

7.9 We note that Cronos appears as a Project of Mutual Interest (PMI) on the Union list adopted by the European Commission, pursuant to the TEN-E Regulation, on 28 November 2023.[62] This may expedite the project's development. Nonetheless, the evidence provided does not assure Ofgem it is likely the project would connect at its earliest possible timeframe in the year 2032. Cronos stated within its submitted material that the project has already been delayed in its development owing to the project's status as a first of a kind independently developed interconnector in Belgium.

Plans for regulatory approval in the connecting country

7.10 In Cronos' explanation of its plans for regulatory approval in Belgium, the developer communicates its awareness of the apparent legal requirement in Belgium for Elia to own a 50% share in an interconnector project. Cronos nonetheless plans to be a regulated project fully funded by independent investors.

7.11 Ofgem notes that this plan by the developer to become an independent, project financed interconnector in Belgium has not yet been supported through evidenced engagement with CREG, the regulator in Belgium.

7.12 The developer informed Ofgem that it has presented the plan to be an independent interconnector to the Belgian Government and to CREG. However, we have not been informed of any feedback from either the Belgian Government or CREG on this matter.

7.13 Based on the materials submitted by the developer, it is not clear to Ofgem whether and how the potentially significant legal and regulatory obstacles faced by the project will be resolved via engagement with the Belgian authorities. The developer did not provide sufficient evidence, which could prove to our satisfaction that the Belgian authorities intend to resolve the issue of regulatory approval in the way preferred by the developer and within such timeline that would allow the project to be operational by the end of 2032.

Justification of chosen connection location, capacity and technical design

7.14 The justification for the chosen connection points on both ends of the cable is very limited in Cronos's application. There is no evidence of optioneering for the landing site, onshore cable or converter station, or thorough engagement with the

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[62] The link to the *first Union list of projects of common interest and projects of mutual interest:* [Annex on the first Union list of Projects of Common and Mutual Interest - European Commission (europa.eu)]

transmission system operators on either side of the cable to consider options. There is only a high-level consideration to minimise the interconnector costs through the choices made.

7.15 The technical design for the project within the application is sound however lacking in detail and justification, which impacts Ofgem's understanding of the project's ability to meet availability requirements.

System operability (GC0137)

7.16 The developer confirms through Cronos's application that the project would provide additional ancillary services through Grid Forming Capability. The benefits of this are not captured in the application but rather in NGESO's analysis.

Financing strategy

7.17 Cronos's financing strategy is based on a planned project finance structure. The target gearing level is approximately 62%. The financing plan is supported by non-binding letters from a bank, which has structured and arranged project financing for interconnector projects in GB, and an institutional lender/investor.

Supply chain plans

7.18 Cronos's application demonstrates initial work has been undertaken to engage with potential suppliers and the developer is aware of the steps required to secure a cable contract, outlining in general terms, the main cabling types available in Europe and how the procurement process functions. However the evidence is very high level, and the information provided does not relate back to the Cronos project specifically.

Market modelling analysis

7.19 Cronos has been modelled as a 1.4 GW interconnector between GB and Belgium, connecting in late 2029.

7.20 The following results refer to the MA approach only. This is because the MA approach is the basis of Ofgem's decision making as it presents the more probable picture of the interconnector landscape.

Welfare

7.21 The modelling indicates Cronos delivers a total welfare benefit to GB in all scenarios, driven by strong producer SEW. However, this includes negative consumer SEW impacts for GB in all scenarios due to the anticipated predominant export flows to Belgium causing an increase in wholesale prices.

Revenue Expectations

7.22 The modelling suggests that Cronos would not depend on floor payments throughout its lifetime and instead be expected to provide cap payments to consumers throughout a large proportion of the modelled period. These high revenue predictions are due to the high anticipated price differentials between GB and Belgium. Ofgem is satisfied that Cronos would not be a detriment to consumers in terms of requiring excessive floor top-ups, and could provide benefit to consumers through cap payments.

Decarbonisation

7.23 According to the modelling, Cronos is anticipated to lead to a net increase in CO2 emissions in GB, and a net decrease in Belgium and across Europe across all scenarios. This increase in GB, which is netted off when considering the impact on Europe as a whole, is due to Cronos' expected predominant export flows which leads to higher wholesale prices in GB and the dispatch of more expensive gas-fuelled generation. A cross-border approach to decarbonisation is important for progressing global climate ambitions.

Security of supply

7.24 With regard to security of supply, in LW the introduction of Cronos is anticipated to reduce the number of unserved energy hours in GB compared to the counterfactual by importing electricity in periods of system stress. This would be anticipated to result in savings of £298.2m. Whilst this offers a benefit to consumers, this is not considerable enough to have resulted in a positive consumer SEW under this scenario. For CT and FS, no USE hours are observed before or after the introduction of Cronos, therefore the project does not result in a positive nor negative impact in this regard.

System Impacts analysis

7.25 NGESO has undertaken analysis on the system operability and balancing market (constraint costs) impacts of Cronos. Further information can also be found in NGESO's report published alongside this document.

Constraint costs (balancing market impacts)

7.26 The connection of Cronos is anticipated to result in an increase in constraint costs of between £1.3 to £4.6bn, comparing the lowest (FS) and highest (CT) scenarios of the MA case.

7.27 In general, the analysis suggests that Cronos is anticipated to increase constraint costs on several midland and southern boundaries and relieves congestion on other northern boundaries not as geographically close to the project. Although Cronos does show the potential to reduce constraint costs on some boundaries, this impact is not large enough to mitigate the substantial constraint costs incurred on other parts of the network. Ofgem can infer from this information that Cronos' proposed location on the south of England, alongside its expected predominant exporting usage, results in increased flows in typically constrained parts of the GB network and more balancing actions required to relieve constraints across various boundaries.

7.28 As noted in the overview of NGESO's methodology, if a project were to be approved for a cap and floor regime, grid reinforcement work would likely need to be undertaken by NGESO to alleviate the constraint impact of the interconnector on the system. We cannot be certain of the exact costs and timelines of grid reinforcement that are necessary to accommodate a specific interconnector at this time. Cronos's constraint costs are considerably high in two out of three scenarios, with an upper boundary of £4.6bn in the MA approach. We can anticipate these substantial costs could trigger network reinforcements. NGESO and consumers would have to bear these costs until the works are complete, which is a timing yet undefined. To minimise the impact on the electricity system, we deem it appropriate to only consider projects for a cap and floor regime with low constraint costs or constraint savings, specifically considering the upper boundary of the range of costs which could be incurred. Based on the information we have available, Cronos's constraint cost projections currently pose a significant risk for consumers.

Frequency response

7.29 The modelling suggests that Cronos could be expected to facilitate response savings of between approximately £100mn-£120mn in the MA, with savings projected to be lowest in under LW and highest under FS. Ofgem recognises that the frequency response landscape will change considerably over the next 25 years and therefore there is inherent uncertainty in quantifying the benefits of Cronos in providing frequency response services. However, Ofgem is satisfied with the frequency response savings as suggested by the modelling, particularly because reform of NGESO's ancillary service and balancing markets are designed to make markets more efficient, accessible and liquid which may potentially lead to even greater levels of participation of Cronos than that assumed in this analysis.

Reactive Power

7.30 The NGESO analysis presents that Cronos is anticipated to lead to reactive power savings of approximately £110mn across all three scenarios in the MA approach. This figure is constant across all scenarios, and there is minimal to no variation across the MA approach, due to the little variation in reactive power benefit from an interconnector whether it is importing, exporting, or float. Ofgem notes that this figure likely represents an upper estimate of the potential savings, given that the analysis assumes that all reactive power benefits that could be provided by Cronos are required, which may not be the case. Nonetheless, Ofgem is satisfied with these projected savings as suggested by the analysis.

Restoration

7.31 According to NGESO's analysis, Cronos could be expected to facilitate savings for restoration services of between approximately £40mn and £50mn in the MA approach, with the potential savings being greatest under LW, followed by CT and FS. Ofgem note the uncertainty of this analysis owed to the difficulty in forecasting future cost assumptions and also due to the fundamental changes anticipated in the restoration services landscape over the coming decades.

Avoided RES curtailment

7.32 The analysis by NGESO suggests that the addition of Cronos is estimated to result in approximately 18TWh and 25TWh avoided RES curtailment for the 25-year life of the project under the MA approach. These savings are lower in the LW and higher in the CT and FS scenarios. Ofgem welcomes this projected potential of Cronos to contribute to avoiding RES curtailment.

8. LirIC

Deliverability and maturity assessment

Stage	Requirement	RAG rating
Eligibility to be considered for IPA	A GB connection agreement for connection prior to the end of 2032	
	Licence application made to Ofgem	
IPA	Project Overview	
	Qualitative assessment of risks and dependencies	
	Hard to monetise impacts	
	Project plans	
	Plans for grid connection in connecting country	
	Plans for obtaining regulatory approval in connecting country	
	Justification of chosen location, capacity and design	
	System operability (GC0137)	
	Financing strategy	
	Supply chain plans	

Qualitative assessment of risks and dependencies

8.1 The risk assessment in respect of LirIC assures Ofgem that the developer is knowledgeable and well-prepared to deliver the project by the timelines proposed. Risks are scored and prioritised, specific to the needs of the project and mitigation detail is provided for the highest priority risks.

Hard to monetise impacts

8.2 LirIC's submission was awarded green RAG ratings by Arup for each of the hard to monetise indicators. The developer provided an overview of the project's potential impacts, such as nature conservation, noise, access and transport, alongside describing early mitigation plans.

8.3 The overall RAG rating for the HtM indicator is assigned by Ofgem drawing upon Arup's RAG ratings for the individual HtM components alongside Ofgem's further considerations. Taking into account the above, Ofgem give LirIC a green rating overall for this criterion.

Project plans

8.4 LirIC's application stated it will connect in Q3 2030, with a four-year construction timeline. The project has submitted a detailed milestone plan that is realistic and well-informed, demonstrating the developer is aware of the steps required of them.

8.5 LirIC explain that completion of offshore surveys by Q3 2024 is a critical milestone date to achieve the expected timeline.

8.6 Ofgem understands that since LirIC's submission, the developer has been engaging with NGESO to update LirIC's connection agreement in GB for connection in the year 2032. This is a considerable delay to the original submission and Ofgem note that connection in the year 2032 leaves no room for further delay to the project's development. Ofgem, however, is assured by the developer's submitted material overall that connection in the year 2032 is likely.

Plans for grid connection in the connecting country

8.7 LirIC explain in its application that it submitted a grid connection application to SONI, the TSO in Northern Ireland, in 2022, and a decision is to be expected by spring 2024. SONI is assessing the works required to upgrade the Kilroot substation to allow for LirIC's connection.

Plans for regulatory approval in the connecting country

8.8 A key risk identified in LirIC's submission is the underdevelopment of interconnector-specific regulation and licensing in Northern Ireland, and uncertainty over whether the regulatory framework and/or licence would require new legislation and be available in time for LirIC to start operations by the end of 2032.

8.9 However, LirIC's proactive work to date to engage with the regulator UREGNI and SONI means a plan is now underway to develop the interconnector under current legal frameworks which do not require the creation of new legislation, overcoming these risks and satisfying Ofgem that the project does not face significant obstacles to its development in Northern Ireland.

8.10 LirIC applied for a transmission licence in Northern Ireland in 2023 after extensive engagement with UREGNI, and a final decision is pending following a public consultation. LirIC has submitted letters of support from UREGNI and the Northern Ireland Department for Economy for its inclusion in TYNDP 2024, and both parties have confirmed they are working with LirIC to develop a bespoke regulatory arrangement for the interconnector.

Justification of chosen connection location, capacity and design

8.11 LirIC's application describes and explains the benefits of options being explored for the project's configuration, including coordinated options. The technical optioneering in the application conducted by the developer is robust and considers well the most economic and efficient connection for the project.

System operability (GC0137)

8.12 The developer confirms through LirIC's application that the project would provide additional ancillary services through Grid Forming Capability. The benefits of this are not captured in the application but rather in NGESO's analysis.

Financing strategy

8.13 LirIC's financing strategy is based on a planned project finance structure. Limited detail was provided of the proposed financing, although reference was made to expectations of the project's financing structure matching the Greenlink and Neuconnect financing precedents in the interconnector sector. The financing plan was not supported by letters from potential investors in the project or from potential lenders.

Supply chain plans

8.14 LirIC have submitted evidence of early engagement with suppliers from 2020-2022. The developer expects supply chain constraints to not impact LirIC as strongly as competitors given the project's smaller size.

Market modelling analysis

8.15 LirIC has been modelled as a 700MW interconnector between GB and Northern Ireland, connecting in 2030. Results for this project regarding the connecting country relate to its impact on the SEM (Ireland Single Electricity Market).

8.16 The following results refer to the MA approach only unless stated otherwise. This is because the MA approach is the basis of Ofgem's decision making as it presents a more probable picture of the interconnector landscape.

Welfare

8.17 Arup's modelling suggests that LirIC is expected to deliver negative total SEW across all scenarios of between -£0.6bn and -£1.0bn in the MA approach. This negative total SEW is also present in the FA approach, where the welfare is between -£0.40bn and -£0.45bn. This is due to the predicted predominant exports from GB to the SEM due to the persistent higher wholesale prices in the SEM compared to GB.

8.18 As previously mentioned, if a project were to demonstrate a negative SEW impact to GB under the FA scenario it suggests that the project is unlikely to provide total welfare benefit to GB under a more probable scenario that is less favourable to the project. This is an area of considerable concern for Ofgem, as we cannot be confident that LirIC will have a positive impact for GB as a whole.

Revenue Expectations

8.19 Modelling suggests that LirIC is expected to require very limited floor payments in the early years of operation under LW and CT when CM revenues are considered. Cap payments are also predicted from 2039 in LW. Ofgem is satisfied that LirIC would not be a detriment to consumers in terms of requiring excessive floor top-ups, and could provide benefit to consumers through cap payments.

Decarbonisation

8.20 Under the MA approach, the introduction of LirIC would be estimated to result in a net decrease in CO2 emissions in GB in LW and FS, and also a decrease when accounting only for the SEM, and when accounting for Europe as a whole (including GB). LirIC is projected to lead to carbon savings in both the island of Ireland and GB.

Security of supply

8.21 In regard to security of supply, the introduction of LirIC is expected to contribute to a reduction in USE hours in GB compared to the counterfactual, leading to a reduction in the associated costs of £64.7mn. Ofgem recognises that this saving benefits consumer welfare, however, not to a substantial enough extent to result in a positive consumer SEW value.

System Impacts analysis

8.22 NGESO has undertaken analysis on the system operability and balancing market (constraint costs) impacts of LirIC. Further information can also be found in NGESO's report published alongside this document.

Constraint costs (balancing market impacts)

8.23 Under the MA case, the connection of LirIC is anticipated to result in either constraint savings or constraint costs, with a range of -£0.2bn in constraint savings under CT, to £0.3bn constraint costs under FS.

8.24 The results show that LirIC has potential to increase constraint costs on a particular Scottish boundary, but relieve congestion on other Scottish and northern boundaries owed to its proposed connection location. This suggests that LirIC helps to reduce the north to south flows across GB and the associated balancing actions.

Frequency response

8.25 According to the NGESO analysis, LirIC could be expected to facilitate response savings of between approximately £40mn-£50mn in the MA approach, with FS representing the largest savings, followed by LW and CT. Ofgem recognises that the frequency response landscape will change considerably over the next few decades and therefore there is inherent uncertainty in quantifying the benefits of LirIC in providing frequency response services. However, reform of NGESO's ancillary service and balancing markets are designed to make markets more efficient, accessible, and liquid which may potentially lead to even greater levels of participation of LirIC than that assumed in this analysis.

Reactive Power

8.26 The modelling suggests that LirIC is anticipated to lead to reactive power savings of approximately £50mn across all three scenarios in the MA approach. This figure is constant across all scenarios, and there is minimal to no variation across the MA approach, due to the little variation in reactive power benefit from an interconnector whether it is importing, exporting, or float. Ofgem notes that this figure likely represents an upper estimate of the potential savings, given that the analysis assumes that all reactive power benefits that could be provided by LirIC are required, which may not be the case.

Restoration

8.27 The NGESO analysis presents that LirIC could be expected to facilitate savings for restoration services of between approximately £37mn and £40mn in the MA approach, with the potential savings being greatest under LW, followed by CT and FS. Ofgem note the uncertainty of this analysis due to the difficulty in forecasting future cost assumptions and also due to the fundamental changes anticipated in the restoration services landscape over the coming decades.

Avoided RES curtailment

8.28 The analysis by NGESO suggests that the addition of LirIC is estimated to result in approximately 1TWh and 20TWh avoided RES curtailment for the 25-year life of the project under the MA approach. These savings are extremely marginal in the LW and highest in the CT scenario. This is because CT has high levels of renewable generation combined with low hydrogen production from electrolysis which leads to the highest levels of RES curtailment across the three scenarios, providing LirIC with the greatest opportunity to reduce this curtailment. Ofgem recognises the minimal savings projected under the FS scenario, but is satisfied with the greater potential of LirIC to contribute to avoiding RES curtailment under CT and LW.

9. MaresConnect

Deliverability and maturity assessment

Stage	Requirement	RAG rating
Eligibility to be considered for IPA	A GB connection agreement for connection prior to the end of 2032	
	Licence application made to Ofgem	
IPA	Project Overview	
	Qualitative assessment of risks and dependencies	
	Hard to monetise costs	
	Project plans	
	Plans for grid connection in connecting country	
	Plans for obtaining regulatory approval in connecting country	
	Justification of chosen connection location, capacity and design	
	System operability (GC0137)	
	Financing strategy	
	Supply chain plans	

Qualitative assessment of risks and dependencies

9.1 MaresConnect's risk assessment assures Ofgem that the developer is knowledgeable and well-prepared to deliver the project by the timelines proposed. Risks are scored and prioritised, specific to the needs of the project and mitigation detail is provided for the highest priority risks.

Hard to monetise impacts

9.2 Arup's assessment of MaresConnect's HtM impacts, further detail of which can be found in the MCA report published alongside this document, awarded MaresConnect green RAG ratings against each of the HtM indicators. The developer's submission included its own RAG rating of the severity of the impacts alongside mitigation measures which is indicative of an informed understanding of the potential HtM impacts posed by MaresConnect.

9.3 The overall RAG rating for the HtM indicator is assigned by Ofgem drawing upon Arup's RAG ratings for the individual HtM components alongside Ofgem's further considerations. Taking into account the above, Ofgem give MaresConnect a green rating overall for this criterion. Ofgem is satisfied with the consideration of HtM at this stage.

Project plans

9.4 MaresConnect states it will connect in early 2030, with a construction timeline of three years. The developer states in the application that a positive IPA decision is required before starting marine surveys. The project has submitted a detailed milestone plan that is realistic and well-informed, demonstrating that the developer is aware of the steps required of them.

Plans for grid connection in the connecting country

9.5 Three potential connection locations have been identified in the Republic of Ireland within MaresConnect's application. Engagement with the TSO EirGrid is limited at the application stage. However, the material submitted by the developer evidenced that the regulator in Ireland, CRU, has since directed EirGrid to commence processing MaresConnect's grid connection in Ireland.

Plans for obtaining regulatory approval in the connecting country

9.6 The application in respect of MaresConnect's suggests that engagement has been limited in terms of attaining regulatory approval in the connecting country, owing to a statement within the application that an IPA decision from Ofgem is a prerequisite required by the regulator CRU before the project can be considered for regulatory approval in Ireland. Since MaresConnect's application, in July 2023, the Department for Climate Change in Ireland (DECC) confirmed a new interconnector policy committing to one connection to GB prior to 2030.[63] According to this change in policy, CRU have directed EirGrid to begin processing a grid connection for the project. The details of MaresConnect receiving a cap and floor regime in Ireland remain unclear, however Ofgem is satisfied based on the submitted material that the developer and the regulator are aligned on milestones and timelines for the project.

9.7 The developer of the project demonstrates a good understanding of how the GB cap and floor regime can interact with the regulatory regime in the Republic of Ireland, and a strong understanding of the milestones required to obtain a regulatory regime, mirroring the development of GreenLink.

Justification of chosen connection location, capacity and design

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[63] gov - National Policy Statement on Electricity Interconnection 2023 (www.gov.ie)

9.8 The optioneering for the developer's selection of MaresConnect's GB connection location is robust and demonstrates a good understanding of the wider transmission impacts. Onshore and offshore cable routes have been chosen to avoid known constraints such as existing wind farms in the area. The preferred location triggers no transmission reinforcement works above those already planned.

System operability (GC0137)

9.9 The developer confirms through MaresConnect's application that the project would provide additional ancillary services through Grid Forming Capability. The benefits of this are not captured in the application but rather in NGESO's analysis.

Financing strategy

9.10 MaresConnect's financing strategy is based on a planned project finance structure. The target gearing level is approximately 70%. The financing plan is supported by a letter from the infrastructure investor owning the MaresConnect project. At this stage, we have not yet received evidence in relation to potential providers of debt finance to the project.

Supply chain plans

9.11 MaresConnect have provided a detailed and mature procurement plan, however evidence of engagement with suppliers is limited.

Market modelling analysis

9.12 MaresConnect has been modelled as a 750MW interconnector between GB and the Republic of Ireland. Results for this project regarding the connecting country relate to its impact on the SEM.

9.13 The following results refer to the MA approach only. This is because the MA approach is the basis of Ofgem's decision making as it presents the more probable picture of the interconnector landscape.

Welfare

9.14 Arup's modelling suggests that MaresConnect is expected to deliver negative SEW across all scenarios of between -£0.7bn and -£1.1bn in the MA approach. This negative SEW is also present in the FA approach, where the welfare is between -£0.4bn and -£0.5bn. This is due to the predicted predominant exports from GB to the SEM due to the persistent higher wholesale prices in the SEM compared to GB.

9.15 As previously mentioned, if a project were to demonstrate a negative SEW impact to GB under the FA scenario it suggests that the project is unlikely to provide total welfare benefit to GB under a more probable scenario that is less favourable to the project. This is an area of considerable concern for Ofgem, as we cannot be confident that MaresConnect will have a positive impact for GB as a whole.

Revenue Expectations

9.16 The MA modelling demonstrates that MaresConnect is expected to require very limited floor payments in the early years of operation under LW and CT when CM revenues are considered. Cap payments are also predicted from the late 2030s in CT. This modelling is supportive that MaresConnect would be unlikely to require significant consumer support in the form of floor payments and that the project could deliver benefit to consumers through cap payments.

Decarbonisation

9.17 Under the MA approach, the introduction of MaresConnect would be estimated to result in a net decrease in CO_2 emissions in GB in LW and FS, and also a decrease when accounting only for the SEM, and when accounting for Europe as a whole (including GB). The CT scenario indicates an anticipated increase in CO_2 emissions in GB, this is a consequence of the predominant exports from GB which result in the dispatch of more carbon-intensive gas-fuelled generation. Aside from the CT scenario, MaresConnect is projected to lead to carbon savings in both the island of Ireland and GB.

Security of supply

9.18 Regarding security of supply, the MA analysis demonstrates that MaresConnect would be expected to reduce the number of USE hours in GB under LW in comparison to the counterfactual, with a resulting cost saving of £69.7m. Meanwhile, under CT and LW, there is likely a neutral impact, as no USE hours are observed before or after the introduction of the project. Ofgem recognises that this saving under FS increases consumer welfare, however, this is not to a substantial enough extent to result in a positive consumer SEW value overall.

System Impacts analysis

9.19 NGESO has undertaken analysis on the system operability and balancing market (constraint costs) impacts of MaresConnect. Further information can also be found in NGESO’s report published alongside this document.

Constraint costs (balancing market impacts)

9.20 The connection of MaresConnect is anticipated to result in an increase in constraint costs of between £0.32 to £0.55bn, comparing the lowest (LW) and highest (CT) scenarios of the MA case.

9.21 The analysis shows that MaresConnect increases constraint costs on several northern boundaries but relieves congestion on some midlands boundaries.

Frequency response

9.22 The NGESO analysis presents that MaresConnect could be expected to facilitate response savings of between approximately £15mn-£25mn in the MA approach, with lowest savings in CT and the highest in the FS scenarios. Ofgem recognises that the frequency response landscape will change considerably over the coming decades and therefore there is inherent uncertainty in quantifying the benefits of MaresConnect in providing frequency response services. However, reform of NGESO's ancillary service and balancing markets are designed to make markets more efficient, accessible and liquid which may potentially lead to even greater levels of participation of MaresConnect than that assumed in this analysis.

Reactive Power

9.23 The modelling presents that MaresConnect is anticipated to lead to reactive power savings of nearly £60mn in the MA approach. This figure is constant across all scenarios, and there is minimal to no variation across the MA approach, due to the little variation in reactive power benefit from an interconnector whether it is importing, exporting, or float. Ofgem notes that this figure likely represents an upper estimate of the potential savings, given that the analysis assumes that all reactive power benefits that could be provided by MaresConnect are required, which may not be the case. Nonetheless, Ofgem is satisfied with these projected savings as suggested by the analysis.

Restoration

9.24 The NGESO analysis presents that MaresConnect could be expected to facilitate savings for restoration services of between approximately £35mn and £45mn in the FA approach, with the potential savings being greatest under LW, followed by CT and FS. Ofgem note the uncertainty of this analysis owed to the difficulty in forecasting future cost assumptions and also due to the fundamental changes anticipated in the restoration services landscape over the coming decades.

Avoided RES curtailment

9.25 The analysis by NGESO suggests that the addition of MaresConnect is estimated to result in between approximately 10TWh and 24TWh avoided RES curtailment for the 25-year life of the project under the MA approach. These savings are lowest in the FS and highest in the CT scenario. This is because CT has high levels of renewable generation combined with low hydrogen production from electrolysis which leads to the highest levels of RES curtailment across the three scenarios, providing the greatest opportunity for MaresConnect to reduce this curtailment. Ofgem welcomes this projected potential of MaresConnect to contribute to avoiding RES curtailment.

10. NU-Link

Maturity and deliverability assessment

Stage	Requirement	RAG rating
Eligibility to be considered for IPA	A GB connection agreement for connection prior to the end of 2032	Green
	Licence application made to Ofgem	Green
IPA	Project Overview	Green
	Qualitative assessment of risks and dependencies	Green
	Hard to monetise impacts	Green
	Project plans	Green
	Plans for grid connection in connecting country	Red
	Plans for obtaining regulatory approval in connecting country	Amber
	Justification of chosen connection location, capacity and design	Amber
	System operability (GC0137)	Green
	Financing strategy	Amber
	Supply chain plans	Green

Qualitative assessment of risks and dependencies

10.1 NU-Link's application provides detailed evidence of the approach to risk management and governance, including the detailing of risks across the different project stages and their mitigations. This indicates to Ofgem that NU-Link has a strong internal risk management strategy.

Hard to monetise impacts

10.2 NU-Link's application provided a qualitative exploration of HtM impacts across environmental, local community, noise, and landscape impacts. Arup's assessment of NU-Link's HtM awarded these indicators a green RAG rating, whilst 'other impacts' was awarded a red as the submission did not explore wider issues. More information on Arup's assessment can be found in the MCA report published alongside this consultation.

10.3 The overall RAG rating for the HtM indicator is assigned by Ofgem drawing upon Arup's RAG ratings for the individual HtM components alongside Ofgem's further considerations. Taking into account the above, Ofgem give NU-Link a green rating overall for this criterion.

Project plans

10.4 NU-Link states in its application that it will connect on 31st December 2031, with final investment date in 2027 and a construction timeline of 4 years. NU-Link's submission includes a detailed project plan, presenting key milestones, progress to date, and the key assumptions and constraints on which the planned approach is based. This demonstrates a sound understanding of the process and well-informed approach to achieve its planned connection date in 2031.

Plans for grid connection in the connecting country

10.5 As part of its submission, NU-Link provide evidence of engagement with TenneT to find a viable connection point in the Netherlands prior to the end of 2032, to then come to a grid connection agreement.

10.6 The project submission indicated that Vijfhuizen was identified through TenneT's quick scan process as a suitable connection location. Since project submission, TenneT determined that there was no possibility for an unrestricted[64] connection for NU-Link anywhere in the Netherlands prior to the end of 2031 as NU-Link had requested through the application to Vijfhuizen. The reasoning for this determination is that TenneT make decisions with regard to its connections policy and the National Investment Plan (*Investeringsplan*). This was considered by Ofgem as a material change in the project's circumstances.

10.7 However, when prompted by Ofgem to respond to this material change, NU-Link's developers outlined, firstly, that NU-Link is challenging TenneT on this determination, which is currently under the Dutch regulator ACM's dispute resolution process, and secondly, NU-Link outlined its engagement with TenneT to explore a replacement connection point at Moerdijk, which is currently being assessed by TenneT. Ofgem recognises that NU-Link is currently challenging TenneT's determination on the original connection application, and that ACM will resolve a dispute between the two parties. This development is of concern to Ofgem as it indicates that NU-Link and the Dutch TSO do not agree on the pathway and milestones for grid connection. The developer faces significant obstacles, and if NU-

[64] The GB equivalent of what is stated here as 'unrestricted' connection would be a connection with firm capacity. A restricted connection would allow TenneT to curtail the interconnector according to system needs.

Link opts to continually challenge the determinations of the Dutch authorities to reach a connection date and location that satisfies the requirements for Window 3, the project may face material delays to its connection to resolve such challenges.

10.8 TenneT's decision not to offer capacity to NU-Link prior to 2032 is based upon following its connections policy, which includes having to prioritise projects in the National Investment Plan. Ofgem question why NU-Link did not apply to be part of TenneT's Investment Plan to overcome this obstacle.

10.9 With regard to the proposed connection at Moerdijk, Ofgem recognises that this is an alternative connection point being explored by TenneT, and a decision is pending. However, to come to a minded-to position with the most recent reliable information available to us, we have to account for the latest determination by TenneT that there is no possible unrestricted connection point in the Netherlands prior to 2032. There is the risk present for NU-Link that the only route forward for the project's connection is either one beyond 2032, or one that has non-firm capacity. The feasibility and timing of connection at Moerdijk has at, this point in time, not been assessed, and the developer has not provided sufficient clarity to Ofgem how an alternative application at a different substation overcomes the obstacle of there being no space available on the grid. A connection with non-firm capacity would not be acceptable for Window 3 as the project would risk not realising its full projected benefit if it cannot be operational at full capacity prior to the end of 2032.

10.10 The material submitted does not provide Ofgem confidence that a connection at firm capacity prior to the end of 2032 is possible for NU-Link, nor that the developer has been fully aware of the milestones and engagement required by TenneT to reach a grid connection agreement in the Netherlands.

Plans for regulatory approval in the connecting country

10.11 The developer of NU-Link, in its application, provides its interpretation of the existing requirements related to the Dutch regulated route for interconnectors, where the standard process envisages that interconnectors should be state-owned by TenneT. The developer then outlines, in its submission, EU level legislation and the Trade and Cooperation Agreement (TCA) between the EU and the UK, which identifies a route to market for independently owned project financed interconnectors. Finally, the developer refers to draft energy legislation in the Netherlands (Energiewet 2023), which the developer interprets that once passed, this draft legislation would for the development of independently owned project financed interconnectors.

10.12 After the developer's statement that an independent interconnector may be progressed in the Netherlands, the developer then outlines options for a regulatory model for the project. These are yet to be tested or developed with the Dutch regulator, ACM. The developer of NU-Link refers to an early engagement with ACM, where the action was, first to determine a grid connection point with TenneT before regulatory options could be discussed further.

10.13 Ofgem understands that grid connection is a prerequisite to gaining a regulatory regime for an interconnector in the Netherlands. Therefore, Ofgem is satisfied with engagement to date for this criterion.

Justification of chosen connection location, capacity and design

10.14 There is limited detail in NU-Link's application on optioneering for the choice of connection location in GB. However, the chosen option is sound and technically feasible. Three landing sites in GB were assessed and the lowest capital cost solution preferred.

10.15 The application details some reinforcement work that needs to be taken to accommodate NU-Link, triggered by previous connections.

System operability

10.16 The developer confirms through NU-Link's application that the project would provide additional ancillary services through Grid Forming Capability. The benefits of this are not captured in the application but rather in NGESO's analysis.

Financing strategy

10.17 NU-Link's financing strategy is based on a planned project finance structure. The target gearing level is 70-80%. The financing plan is supported by non-binding letters from fourteen banks/institutional lenders and an export credit agency.

Supply chain plans

10.18 NU-Link's application provides an explanation of their supply chain plans, including their overall approach to procurement, progress to date, and the identification of risks and challenges. Ofgem is satisfied that this presents a thorough understanding of the supply chain process.

Market modelling analysis

10.19 NU-Link has been modelled as a 1.2GW interconnector between GB and the Netherlands, connecting in 2031.

10.20 The following results refer to the MA approach only. This is because the MA approach is the basis of Ofgem's decision making as it presents the more probable picture of the interconnector landscape.

Welfare

10.21 The modelling suggests that NU-Link is expected to deliver total SEW benefits for GB in all scenarios. This is driven by strong producer welfare, marginally positive IC welfare, but negative consumer welfare in GB across all scenarios. Ofgem recognises that this outcome is largely due to NU-Link being anticipated to be a predominant exporter and therefore contributing to an increase in wholesale prices in GB.

Revenue Expectations

10.22 NU-Link is not expected to require floor payments in any scenario, and is expected to provide cap payments to consumers across all years in CT, the early years in LW, and the later years in FS. Ofgem is satisfied that NU-Link would not be a detriment to consumers in terms of requiring excessive floor top-ups, and could provide benefits to consumers through cap payments.

Decarbonisation

10.23 The modelling suggests that NU-Link would lead to a net increase in CO2 emissions in GB, and a net decrease in the Netherlands and across Europe. The increase in GB, which is netted off when considering the impact on Europe as a whole, is due to NU-Link's dominant export flows to the Netherlands, which contributes to the dispatch of thermal generation and the increase of emissions in GB. The opposite is true for the Netherlands, as GB imports displace gas-fuelled generation from the dispatch order. A cross-border approach to decarbonisation is important for progressing global climate ambitions.

Security of supply

10.24 NU-Link is expected to reduce the number of USE hours in GB compared to the counterfactual under LW, as from 2040 energy supply in GB is projected to fall short of demand during periods of system stress. NU-Link therefore reduces USE and substantially reduces costs by £311.6m. Under CT and FS scenarios, there are no observed USE before or after the introduction of NU-Link, therefore the project does not have positive nor negative impact on USE under these scenarios.

10.25 Ofgem is also not concerned about the neutral impact of NU-Link on USE under CT and FS, given that USE represents only one proxy for security of supply. We therefore have confidence that NU-Link could offer additional security of supply benefits by other means.

System Impacts analysis

10.26 NGESO has undertaken analysis on the system operability and balancing market (constraint costs) impacts of NU-Link. It has assessed the five indicators explored below and detailed in Section 3 of this document. Further information can also be found in NGESO's report published alongside this document.

Constraint costs (balancing market impacts)

10.27 The connection of NU-Link is anticipated to result in an increase in constraint costs of between £0.01bn to £1.25bn, comparing the lowest (FS) and highest (CT) scenarios of the MA case.

10.28 In general, NU-Link is anticipated to increase constraint costs on several northern boundaries, but relieve congestion on certain midlands boundaries.

Frequency response

10.29 The modelling suggests that NU-Link could be expected to facilitate response savings of between approximately £40mn-£70mn across the 25-year life of the project in the MA approach. These savings are highest under the FS scenario, and lowest under LW. Ofgem recognises that the frequency response landscape will change considerably over the coming decades and therefore there is inherent uncertainty in quantifying the benefits of NU-Link in providing frequency response services. However, reform of NGESO's ancillary service and balancing markets are designed to make markets more efficient, accessible and liquid which may potentially lead to even greater levels of participation of NU-Link than that assumed in this analysis.

Reactive power

10.30 The NGESO analysis demonstrates that the introduction of NU-Link is anticipated to lead to reactive power savings of approximately £87mn in the MA approach. This figure is constant across all scenarios, and there is minimal to no variation across the MA approach, due to the little variation in reactive power benefit from an interconnector whether it is importing, exporting, or float. Ofgem notes that this figure likely represents an upper estimate of the potential savings, given that the analysis assumes that all reactive power benefits that could be provided by NU-Link are required, which may not be the case. Nonetheless, Ofgem is satisfied with these projected savings as suggested by the analysis.

Restoration

10.31 According to the analysis by NGESO, NU-Link could be expected to facilitate savings for restoration services of between approximately £35mn and £43mn across all scenarios in the MA approach, with the potential savings being greatest under LW, followed by CT and FS. Ofgem notes the uncertainty of this analysis owed to the difficulty in forecasting future cost assumptions and also due to the fundamental changes anticipated in the restoration services landscape over the coming decades.

Avoided RES curtailment

10.32 The NGESO modelling suggests that the addition of NU-Link is estimated to result in approximately 30TWh and 70TWh avoided RES curtailment for the 25-year life of the project under the FA approach. These savings are lower in the LW and FS scenario and highest in the CT scenario. This is because CT has high levels of renewable generation combined with low hydrogen production from electrolysis which leads to the highest levels of RES curtailment across the three scenarios which provides the greatest opportunity for NU-Link to reduce this curtailment. Ofgem welcomes this projected potential of NU-Link to contribute to avoiding RES curtailment.

11. Tarchon

Maturity and deliverability assessment

Stage	Requirement	RAG rating
Eligibility to be considered for IPA	A GB connection agreement for connection prior to the end of 2032	
	Licence application made to Ofgem	
IPA	Project Overview	
	Qualitative assessment of risks and dependencies	
	Hard to monetise impacts	
	Project plans	
	Plans for grid connection in connecting country	
	Plans for obtaining regulatory approval in connecting country	
	Justification of chosen connection location, capacity and design	
	System operability (GC0137)	
	Financing strategy	
	Supply chain plans	

Qualitative assessment of risks and dependencies

11.1 Tarchon's submission includes a high-level description of risks in the development and construction phase of an interconnector, without relating them to the project itself. An amber rating was given as the developer did not prioritise risks, explain the impact or consequences of a risk occurring to the project specifically, or provide detail of mitigation measures.

Hard to monetise impacts

11.2 Tarchon's submission provided qualitative analysis of the potential impact of the project on the environment and local community, scoring green ratings in Arup's MCA. Ofgem considers this analysis to be representative of the developer having due consideration of the project's potential impacts on the local area in respect of these indicators. However, the submission did not provide an assessment of noise impacts, and consequently was awarded a red rating against this indicator by Arup. Ofgem tolerate this omission at this stage but would expect the developer to undertake a more thorough assessment in the upcoming planning and development processes.

11.3 The overall RAG rating for the HtM indicator is assigned by Ofgem drawing upon Arup's RAG ratings for the individual HtM components alongside Ofgem's further considerations. Taking into account the above, Ofgem give Tarchon an amber rating overall for this criterion.

Project plans

11.4 Tarchon states it plans to connect on 31st October 2030, with a construction timeline of three years. The project has submitted a detailed milestone plan which is realistic and well-informed, demonstrating the developer is aware of the steps required of them. We note that a 3-year construction period may be vulnerable to delay, however, Tarchon is nonetheless projected to connect well in advance of the end of 2032. As noted in the risks and dependencies section, more detail on mitigation and contingency strategies would be beneficial.

Plans for grid connection in the connecting country

11.5 Tarchon's application explains that a grid feasibility study has been conducted by TenneT and that Niederlangen was identified as the optimal connection point. Niederlangen is a new substation with an expected commissioning date of 2029/2030, and TenneT estimate through the feasibility study that the works should be completed in time for Tarchon to connect within the timelines for Window 3. We note, however, that this remains a risk for the project. The developer now has to conduct a more detailed grid study with TenneT to further progress the project.

Plans for obtaining regulatory approval in the connecting country

11.6 Tarchon's application shows evidence of initial engagement with the German regulator, the Bundesnetzagentur (BNetzA), and notes that the German TSO, TenneT, had included the project in the recommendations for the German National Development Plan sent to BNetzA for the final approval.

11.7 Since application, Tarchon has been included in the German National Development Plan 2023-2037. In addition, Tarchon appears as a Project of Mutual Interest (PMI) on the Union list adopted by the European Commission, pursuant to the TEN-E

Regulation, on 28 November 2023.[65] Ofgem have not identified any obstacles to the project receiving regulatory approval in Germany.

Justification of chosen connection location, capacity and design

11.8 The optioneering for the selection of the project's GB connection location is robust and demonstrates a good understanding of the wider transmission impacts. Offshore and onshore cable routes are high level at this stage and may be subject to revision following detailed survey works.

11.9 The application in respect of Tarchon proposes 1.4GW capacity, however Ofgem found no justification for this in the application.

System operability (GC0137)

11.10 The developer confirms through Tarchon's application that the project would provide additional ancillary services through Grid Forming Capability. The benefits of this are not captured in the application but rather in NGESO's analysis.

Financing strategy

11.11 Tarchon's financing strategy is based on a planned project finance structure. The target gearing level is approximately 80%. The financing plan is supported by non-binding letters from a bank which has structured and arranged project financing for interconnector projects in GB and from an institutional lender/investor.

Supply chain plans

11.12 Tarchon's application demonstrates initial work has been undertaken to engage with potential suppliers and the developer is aware of the steps required to secure a cable contract, outlining in general terms the main cabling types available in Europe and how the procurement process functions. However, the evidence is very high level, and the information provided does not relate back to the Tarchon project specifically.

Market modelling analysis

11.13 Tarchon has been modelled as a 1.4GW interconnector between GB and Germany, connecting in 2030.

[65] The link to the *first Union list of projects of common interest and projects of mutual interest:* [Annex on the first Union list of Projects of Common and Mutual Interest - European Commission (europa.eu)]

11.14 The following results refer to the MA approach only. This is because the MA approach is the basis of Ofgem's decision making as it presents the more probable picture of the interconnector landscape.

Welfare

11.15 The modelling indicates that Tarchon would deliver a total welfare benefit to GB in all scenarios, driven by strong producer SEW. However, this includes negative consumer SEW impacts for GB in all scenarios due to the anticipated predominant export flows to Germany causing an increase in wholesale prices.

Revenue Expectations

11.16 The modelling suggests that Tarchon would not depend on floor payments throughout its lifetime and instead would be expected to provide cap payments to consumers throughout a large proportion modelled period. These high revenue predictions are due to the high anticipated price differentials between GB and Germany. Ofgem is satisfied that Tarchon would not be a detriment to consumers in terms of requiring excessive floor top-ups, and that Tarchon could provide benefit to consumers through cap payments.

Decarbonisation

11.17 According to the modelling, Tarchon is anticipated to lead to a net increase in CO2 emissions in GB, and a net decrease in Germany and across Europe as a whole (including GB) across all scenarios. The increase in GB, which is netted off when considering the impact on Europe as a whole, is a consequence of Tarchon's expected predominant export flows, which leads to higher wholesale prices in GB and the dispatch of more expensive gas-fuelled generation. A cross-border approach to decarbonisation is important for progressing global climate ambitions.

Security of supply

11.18 In regard to security of supply, in LW the introduction of Tarchon is anticipated to reduce the number of unserved energy hours in GB compared to the counterfactual by importing electricity in periods of system stress. This would be anticipated to result in savings of £347.6m. Whilst this offers a benefit to consumers, this is not considerable enough to have resulted in a positive consumer SEW under this scenario. For CT and FS, Tarchon is anticipated to have a neutral impact on security of supply, as no USE hours are observed before or after the introduction of Tarchon.

System Impacts analysis

11.19 NGESO has undertaken analysis on the system operability and balancing market (constraint costs) impacts of Tarchon. Further information can also be found in NGESO's report published alongside this document.

Constraint costs (balancing market impacts)

11.20 The connection of Tarchon is anticipated to result in either constraint savings or an increase in constraint costs, with a range between -£0.2 to £1.3bn, comparing the lowest (FS) and highest (LW) scenarios of the MA case.

11.21 The analysis shows that in general, Tarchon increases constraint costs on several midland and northern boundaries but relieves congestion on a range of other boundaries, but not to a large enough extent to negate the total constraint costs projected over the 25-year life of the project. The constraint saving of -£0.02bn is only present in the FS case which assumes that GB does not reach net zero, Ofgem considers it is more accurate to view the CT and LW cases as the more accurate estimation of Tarchon's constraint costs.

Frequency response

11.22 The modelling suggests that Tarchon could be expected to facilitate response savings of between approximately £70mn-£90mn in the MA approach, with LW representing the largest savings. Ofgem recognises that the frequency response landscape will change considerably over the coming decades and therefore there is inherent uncertainty in quantifying the benefits of Tarchon in providing frequency response services. However, reform of NGESO's ancillary service and balancing markets are designed to make markets more efficient, accessible and liquid which may potentially lead to even greater levels of participation of Tarchon than that assumed in this analysis.

Reactive Power

11.23 NGESO's analysis suggests that Tarchon is anticipated to lead to reactive power savings of approximately £110mn in the MA approach. This figure is constant across all scenarios, and there is minimal to no variation across the MA approach, due to the little variation in reactive power benefit from an interconnector whether it is importing, exporting, or float. Ofgem notes that this figure likely represents an upper estimate of the potential savings, given that the analysis assumes that all reactive power benefits that could be provided by Tarchon are actually required, which may not be the case. Nonetheless, Ofgem is satisfied with these projected savings as suggested by the analysis.

Restoration

11.24 The modelling by NGESO presents that Tarchon could be expected to facilitate savings for restoration services of between approximately £40mn and £50mn in the MA approach, with the potential savings being greatest under LW, followed by CT and FS. Ofgem note the uncertainty of this analysis owed to the difficulty in forecasting future cost assumptions and also due to the fundamental changes anticipated in the restoration services landscape over the coming decades, but is satisfied with these projected savings.

Avoided RES curtailment

11.25 NGESO's analysis suggests that the addition of Tarchon is estimated to result in approximately 45TWh and 1180TWh avoided RES curtailment for the 25-year life of the project under the MA approach. These savings are lowest under the LW scenario and considerably higher in the CT scenario. This is because CT has high levels of renewable generation combined with low hydrogen production from electrolysis which leads to the highest levels of RES curtailment across the three scenarios which provides the greatest opportunity for Tarchon to reduce this curtailment. Ofgem welcomes this projected potential of Tarchon to contribute to avoiding RES curtailment, particularly given the high magnitude of estimated savings under CT.

12. IPA conditions

12.1 As with previous windows, our IPA conditions remain an important tool to protect consumers by providing Ofgem with the ability to intervene if a project has materially deviated from the basis upon which it was awarded a cap and floor regime in principle.

12.2 Our minded-to position to award Tarchon a cap and floor regime in principle is contingent upon the following conditions (the 'IPA conditions'):

1. Operations prior to the end of 2032: If there is a change in circumstances before the FPA decision that means a project is no longer be able to become operational by the end of 2032, we may choose to conduct an IPA review of the project. This would include Ofgem undertaking a reassessment of the IPA in order to confirm whether or not the project continues to be in consumers' interests and should continue to hold a cap and floor regime in principle.
2. Material change: If any information given to us before FPA decision leads us to consider that the project no longer meets the basis upon which it was granted an cap and floor regime in principle, then we may choose to conduct an IPA review of the project. This information includes changes to project parameters such as timelines, connection date, project configuration, commercial arrangements, regulatory support or grid connection in the connecting country, and costs.
3. The developer must submit detailed information on costs for our FPA to start within three years of an IPA decision. This information will need to be informed by detailed discussions with the supply chain and tender returns.
4. The developer must give formal written notice of any material changes to the project. Following any such change, the developer must explain the rationale for the change and the implications on project cost and delivery.
5. The developer must submit quarterly written reports on progress against a number of key development milestones, including (but not limited to) development work, consenting and permitting, procurement, financing, operational management plans and costs, project management and other factors that had an impact on the IPA assessment under which the project was granted a cap and floor regime.
6. The developer must confirm the timing of FPA submission in writing to Ofgem at least two months before the expected submission date.

13. Next steps

13.1 It is important to note this is a minded-to consultation, and we remain open to feedback from any interested stakeholders and any relevant additional evidence from applicants before communicating our final decision on any of the applicant projects. We also remain open to additional evidence from applicant projects.

13.2 When the consultation closes, we will review responses and publish a final decision in mid-2024 to either:

(a) confirm our minded-to position as set out in this consultation; or

(b) appropriately amend our position if the amendments are justified as a result of the consultation process.

13.3 Developers which pass the IPA will then have three years to submit detailed cost information for the FPA stage. The provisional cap and floor levels will be set on a project-by-project basis at the FPA stage following our cost assessment.

13.4 We cannot comment on the opening of Window 4 at this time.

Appendix 1 Glossary

A

Aminth

A proposed electricity interconnector project within Window 3, connecting GB and Denmark, with a proposed capacity of 1.4GW.

Ancillary services

Contracted services (such as frequency response and restoration) available to the System Operator in order to maintain balance and to ensure the security and quality of electricity supply across the system.

AQUIND

A proposed electricity interconnector project within Window 3, connecting GB and France, with a proposed capacity of 2GW.

ARUP

Ove Arup and Partners.

ASTI

Accelerated Strategic Transmission Investment. A policy programme developed by Ofgem to grant select GB onshore transmission projects exemptions from competition, to enable fast paced development of strategically significant network infrastructure.

Avoided RES Curtailment

Avoided Renewable Energy Supply Curtailment. Curtailment refers to the reduction of power reduction when there is too much electricity in the grid or when there is not enough power in the grid. Curtailments aims at lessening the stress on the grid.

B

BEIS

Department of Business, Energy and Industrial Strategy. The former name for the HM Government department which as of February 2023 is now the Department for Energy Security and Net Zero.

Black Start

An alternative name for 'Restoration', see below.

C

Capacity Market Notices

A signal four hours in advance that there may be less generation available than National Grid, acting as System Operator, expects to need to meet national electricity demand on the transmission system.

Cap and Floor

The regulated route for interconnector development in GB. It sets a minimum and maximum return that interconnector developers can earn over 25 years.

CBA

Cost-benefit analysis. An evaluation of project costs against the monetisable benefits that such a project could provide.

CfD

The Contracts for Difference scheme - the Government's main mechanism for supporting new low-carbon electricity generation projects in GB. Generators compete in auctions to receive CfD support, and if granted a CfD, the prices received by generators are fixed at the 'strike price' over a number of years. When the market price falls below the strike price, a project is compensated, and when the market price sits above, the generator pays the excess back.

CION

Connections Infrastructure Options Note. This is an optioneering exercise undertaken between an offshore transmission developer, a TO, and NGESO, to identify the most economic and efficient connection location on the GB shore. This takes place before a connection offer is granted to a project by NGESO.

CM

Capacity Market. The CM ensures security of electricity supply by providing a payment for reliable sources of electricity alongside their electricity revenues, to ensure they deliver energy when needed.

Constraint costs

A constraint occurs when the capacity of transmission assets is exceeded so that not all of the required generation can be transmitted to other parts of the network, or an area of demand cannot be supplied with all of the required generation. The associated costs are the actions to re-dispatch generators to correct these system issues. Also known as balancing market impacts.

Consumer Welfare

The economic benefit (welfare) derived by consumers as measured by the Cost Benefit Analysis. Also known as consumer surplus.

Cost assessment

A process which enables Ofgem to determine the efficient levels of project capital expenditure.

Cronos

A proposed electricity interconnector project within Window 3, connecting GB and Belgium, with a proposed capacity of 1.4GW.

CRU

Commission for Regulation of Utilities, the electricity regulator for the Republic of Ireland.

CSNP

Centralised Strategic Network Plan. This is a concept being developed by Ofgem, for implementation by the Future System Operator, to create a new transmission network planning output to inform future network investment.

CT

Consumer Transformation. One of the four FES 2022 scenarios.

D

Demand Flexibility Service

The Demand Flexibility Service allows consumers to earn rewards for shifting electricity usage away from peak demand hours. This allows the NGESO to manage supply through periods when margins are tight.

DSR

Demand Side Response. DSR involves businesses increasing, decreasing, or shifting their electricity use – in response to a signal – to help balance GB's electricity system. In return they receive financial incentives, lower their bills, and reduce their carbon footprint.

E

ENTSO-E

European Network of Transmission System Operators for Electricity.

EU

European Union.

F

FA

First Additional approach. This approach is used by Arup to analyse the value of each interconnector individually, assuming that it is the sole new project to be constructed. It does not consider the addition of any other interconnector project in GB aside from the applicant. The FA approach allows Arup to explore the value of a project without outside influence.

FS

Falling Short. One of the four FES22 scenarios. Known as Steady Progression in previous iterations of the FES.

FES 2022

Future Energy Scenarios 2022 developed by NGESO.

FPA

Final Project Assessment. The stage at which Ofgem examines detailed cost information for projects that apply for a cap and floor regime and have been recommended at the initial project assessment stage.

Frequency Response

Frequency Response is a continuously provided service used by NGESO to manage the normal second-by-second changes in frequency on the national transmission system. This is conducted by turning generation up and down to avoid imbalances in frequency, and comes with associated costs reflected in the network charge on consumer bills.

FSO

Future System Operator. Now known as the National Energy System Operator (NESO)

G

GB

Great Britain.

GDPR

General Data Protection Regulation.

GEMA

Gas and Electricity Markets Authority.

Grid Forming Capability

Introduced in Grid Code change 0137. Aims to enhance the capability of conventional power electronic converter plant (e.g. wind farms, HVDC interconnectors and solar parks), so that the plant responds more like a traditional synchronous plant and is able to offer an additional grid stability service.

GW

Gigawatt.

H

HND

Holistic Network Design. A network planning output developed by NGESO in 2022 that creates a single integrated plan to connect 23GW of select offshore wind projects to the GB shore.

HVDC

High Voltage Direct Current.

I

IC

Interconnector. Physical links which allow for the transfer of electricity across international borders.

ICPR

Ofgem's Interconnector Policy Review.

IPA

Initial Project Assessment. The initial project assessment is Ofgem's first assessment for an interconnector applying to a cap and floor investment window, where we assess whether there is a needs case for the project based on projected costs and benefits.

Interconnector Welfare

The economic benefit (welfare) derived by interconnector owners as measured by the Cost Benefit Analysis.

L

Locational Pricing

Locational pricing is a market design where wholesale prices reflect the value of energy at different geographical points across the network.

LirIC

A proposed electricity interconnector project within Window 3, connecting GB and Northern Ireland, with a proposed capacity of 750MW.

LW

Leading the Way. One of the four FES 2022 scenarios.

M

MaresConnect

A proposed electricity interconnector project within Window 3, connecting GB and the Republic of Ireland, with a proposed capacity of 750MW.

MA

Marginal Additional approach. This approach is used by Arup and NGESO in their modelling to assess the impacts of a specific project against the base level of interconnection within FES 2022 as well as the other OHA and Window 3 applicant projects.

MINEZK

Ministry for Economic Affairs and Climate Policy in the Netherlands.

MW

Megawatt.

MCA

Multi-Criteria Assessment. In the context of this consultation this refers to a specific methodology conducted by Arup for the presentation of results in the cost-benefit analysis.

N

NESO

National Energy System Operator

NETS

National Electricity Transmission System.

NGESO

National Grid Electricity System Operator. NGESO and ESO are used interchangeably in this consultation.

NGET

National Grid Electricity Transmission. NGET owns and maintains the onshore high-voltage electricity transmission system in England and Wales.

NOA

Network Options Assessment. A network planning exercise conducted by NGESO which provides a recommendation for which network reinforcement projects should receive investment and when. A separate report is created to assess interconnectors, the NOA for ICs.

NRA

National Regulatory Authority.

NU-Link

A proposed electricity interconnector project within Window 3, connecting GB and the Netherlands, with a proposed capacity of 1.2GW.

O

OBZ

Offshore Bidding Zone. A bidding zone is the largest geographical area within which market participants are able to exchange energy without capacity allocation.

OHA

Offshore Hybrid Assets. Offshore electricity infrastructure with dual functionality, combining transport of offshore wind energy to shore and interconnectors. In GB, there are two asset types which fall under the concept of an OHA: a multi-purpose interconnector (MPI), forming a whole OHA, and a non-standard interconnector (NSI), forming part of an OHA.

Ofgem

Office of Gas and Electricity Markets. Ofgem supports and acts on behalf of the Gas and Electricity Markets Authority (GEMA).

P

PCI

Projects of Common Interest. This is a key infrastructure project aimed at completing the European internal energy market and allowing the EU to achieve its energy and climate objectives. Unlike an PMI, this is an intra-EU project. PCIs are included in the Union list, established pursuant to the TEN-E Regulation 2022, and can benefit from accelerated permitting and consenting procedures as well as from the regulatory support at the national level.

PMI

Projects of Mutual Interest. This is a key cross-border energy infrastructure project between the EU and non-EU state, which contributes to the energy and climate policy objectives of the Union. This is a new category of projects that can be supported following the revision of the TEN-E Regulation 2022. PMIs will be included in the Union list, established pursuant to the TEN-E Regulation 2022, and will be able to benefit from accelerated permitting and consenting procedures as well as from the regulatory support at the national level.

Producer

Term used for electricity generators in the context of the Cost Benefit Analysis.

Producer Welfare

Is the economic benefit (welfare) derived by producers as measured by the Cost Benefit Analysis. Also known as consumer surplus.

R

Reactive Power

The ancillary service used by NGESO to manage voltage levels locally and ensure the voltage profile of the transmission system stay within statutory limits. This is achieved by instructing generators to either absorb reactive power (decrease their voltage) or generate reactive power (increase voltage).

RAG

Red-Amber-Green.

Restoration

The procedure to recover from a total or partial shutdown of the GB transmission system. This entails isolated power stations being started individually and gradually being reconnected to each other in order to form an interconnected system again.

REMA

Review of Electricity Market Arrangements. A consultation conducted by DESNZ to explore a variety of proposals for wholesale market reform to enable a decarbonised, cost-effective and secure electricity system. Examples of options under the review include locational pricing, alternatives to marginal pricing, and splitting the wholesale market.

RES

Renewable Energy Sources.

S

SEM

The Integrated Single Electricity Market. It is a single wholesale market for the island of Ireland and Northern Ireland, that has been in operation since 2007 and is jointly regulated by UREGNI and CRU, and operated by the Single Electricity Market Operator.

SEW

Socio-Economic Welfare. Also referred to as Consumer Welfare.

SO

System Operator. The entity charged with operating the GB high voltage electricity transmission system, currently NGET.

T

Tarchon

A proposed electricity interconnector project within Window 3, connecting GB and Germany, with a proposed capacity of 1.4GW.

TEN-E Regulation 2022

Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure that repealed Regulation (EU) No 347/2013 (i.e. the old TEN-E Regulation 2013).

TO

Transmission Owner. The owner of transmission assets. In GB, this entity also owns and maintains the onshore transmission system. There are three regional TOs in GB- Scottish Power Energy Networks, Scottish and Southern Electricity Networks, and National Grid Electricity Transmission.

TSO

Transmission System Operator. Entity in charge of operating transmission assets, either for electricity or gas. In this consultation this term has been used to describe non-GB system operators.

TWh

Terawatt hour.

U

Unserved Energy Hours

A measure of the amount of time electricity demand exceeds supply.

V

VSC

Voltage Source Converters.