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Interconnector Capacity Analysis

Annex covering Interconnector Analysis

Annex 9 Interconnector Capacity Analysis was withdrawn in December 2025

NESO
National Energy System Operator

tCSNP2 Refresh methodology Annex 9 *Interconnector Capacity Analysis* was withdrawn in December 2025 following the derogation to licence condition C13 agreed by Ofgem. The derogation relieved NESO of the obligation as the Interconnector Capacity Analysis work area has been superseded by the new SSEP/CSNP interconnector assessments process.

9.1 Overview

1. This chapter provides an overview of the aims of the Interconnector Capacity Analysis details the methodology which NESO will adopt for the analysis and publication within the tCSNP2 Refresh 2025.
2. Since the publication of the first NOA (2015/16), we have developed our Interconnector Capacity Analysis methodology for each year. We wish to continue to develop the Interconnector Capacity Analysis methodology so that we produce an analysis that continues to be of increasing value for our stakeholders.
3. The primary purpose of Interconnector Capacity Analysis will continue to provide a market and network assessment of the optimal level of interconnection capacity to GB. This is undertaken by evaluating a range of factors, including socio-economic welfare, that is the overall benefit to society of a particular option, as well as constraint costs and capital expenditure costs. Carbon costs and Renewable Energy Sources (RES) curtailment levels will also be assessed.
4. Interconnector Capacity Analysis does not attempt to assess the viability of current or future projects. The final insights are largely independent of specific projects currently under development and Interconnector Capacity Analysis does not provide any project-specific results.
5. Previous Interconnector Capacity Analysis considered point to point interconnection and Offshore Hybrid Assets between GB and potential European connecting countries. The hybrid interconnectors (OHAs); that include connections to more than two countries and/or also incorporate connections to offshore windfarms in the North Sea or Irish Sea. We will consider the impact of OHAs for Interconnector Capacity Analysis 2025.

9.2 Key changes for the 2024 methodology

1. Previous Interconnector Capacity Analysis have used an iterative step by step process, that determines the optimal level of interconnection based on maximising the Net Present Value of SEW, constraint savings and CAPEX costs.
2. In tCSNP2 Refresh the base level of interconnection will include all the projects currently operational and those with Cap and Floor Window 1 & 2. We will also include all the projects those were given positive decision from Cap and Floor Window 3.

9.3 Factors for the assessment of future interconnection

1. **Social and Economic Welfare (SEW), CAPEX and Attributable Constraint Costs (ACC)**: these are the most significant criteria for identifying the optimal level of interconnection. Constraint costs refer to GB network congestion costs borne by GB consumers because of interconnection. Therefore, these factors will be used in the analysis to determine the economically optimal level of interconnection.
2. **System Operability impacts:** this is an important area that we have incorporated new analysis in Interconnector Capacity Analysis. The services that we will analyse include frequency response, and reactive response.
3. **Carbon costs:** modelling facilities allow for the extraction of total carbon emissions resulting from specific market states under different scenarios, thus the carbon savings or increases associated with various levels of interconnection can be presented with commentary.
4. **Renewable Energy Sources (RES) integration:** modelling facilities allow for the investigation of the impact of interconnection on renewable generation. This can be reviewed through investigating the reduction or increase in renewable generation curtailment driven by the optimal level of interconnection being in place in future years, rather than the currently forecast level.
5. Changes in carbon emissions will be used to optimise the level of interconnection.
6. Operational costs, other environmental costs, and other social benefits, such as local economy growth are outside the scope of this methodology.

9.4 Cost estimation for interconnection capacity

1. The cost of building interconnection capacity varies significantly between different projects - key drivers are convertor technology, cable length and capacity of cable. Estimating costs for generic interconnectors between European markets and GB is therefore challenging. We will continue to use the latest publicly available data to update our cost assumptions.
2. Subsea cable costs will be identified by estimating the furthest and shortest realistic subsea cable length and taking the average distance for each market to GB zone permutation. The length of the cable will vary with the GB zone it is connecting to, and the measurements will be taken between these to the nearest 5km.
3. Onshore connection costs will be excluded as the interconnector study cases are zone specific but not substation specific.
4. The convertor station assumed value will be drawn from an average of known HVDC project costs in the public domain.
5. We will investigate sourcing data to enable generic OHAs to be modelled.
6. As connection costs can occur across a range of years, discounting is employed to standardise each cost in Present Value. This is done with the Social Time Preference Rate (STPR) of 3.5%. Additionally, the cost of capital is accounted for by using Weighted Average

Cost of Capital (WACC) of 5.38% for interconnectors, drawn from a publicly available Ofgem report.[1]

9.5 Components of welfare benefits of interconnection

1. This section outlines the definition of socio-economic welfare. The purpose of this section is to give the theoretical background of assessing the impact of connected importing and exporting markets on consumers, producers and interconnectors triggered by another interconnector.

9.5.1 Socio-economic welfare

1. Socio-economic welfare (SEW) is a common indicator used in cost-benefit analysis of projects of public interest. It captures the overall benefit, in monetary terms, to society from a given course of action. It is important to understand it is an aggregate of different parties' benefits - so some groups within society may lose money because of the option taken. The society considered may be a single nation, GB, or the wider European society, in which case the benefits to European consumers and producers would be a part of the calculation. We intend to calculate SEW divided into GB and connecting country.
2. SEW benefits of an interconnector includes the following three components:
   a) Consumer surplus, derived as an impact of market prices seen by the electricity consumers.
   b) Producer surplus, derived as the impact of market prices seen by the electricity producers.
   c) Interconnector revenue or congestion rents, derived as the impact on revenues of interconnectors between different markets.

9.5.2 Constraint cost implications of interconnection

1. The impact on constraint costs is dependent on the location of the interconnector on the GB network and the level of onshore reinforcement built to accommodate the interconnector. Further detail regarding optimal locations to connect will be output based upon the SEW, CAPEX and constraint costs calculated on the network with the interconnectors under consideration.
2. Constraint costs are incurred on the network when power that is economically "in merit" is limited from outputting due to network restrictions. In this event, NESO will incur balancing mechanism costs to turn down the generation which is not able to output and offer on generation elsewhere on the system to alleviate the constraint.

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[1] Ofgem (2024) *'Decision on the consultation to modify the inflation index used in the calculation of Interest During Construction (IDC) and the IDC rates to apply during 2024-25 for offshore transmission projects and Window 3 cap and floor electricity interconnectors'* Available at: https://www.ofgem.gov.uk/sites/default/files/2024-03/2024-25%20IDC%20Decision%20letter.pdf

9.5.3 Modelling

1. We will use our pan-European market model to forecast the Socio-Economic Welfare (SEW) and the Attributable Constraint Costs (ACC).
2. It is an economic dispatch model which can simulate all ENTSO-E power markets simultaneously from the bottom up i.e., it can model individual power stations for example. It includes demand, supply and infrastructure and balances supply and demand on an hourly basis.
3. The GB electricity system is represented by a series of zones that are separated by boundaries. Generators are allocated to their relevant zone based on where they are located on the network, and then the appropriate demand is allocated to that zone. The boundaries, which represent the actual transmission circuits facilitating the zonal connectivity, have a maximum capability that restricts the amount of power which can be securely transferred across them.
4. The Socio-Economic Welfare is calculated by summing the producer surplus, consumer surplus and interconnector revenue. The consumer surplus is the difference between the value of lost load and the wholesale price. The producer surplus is calculated and summed per plant based upon their Short Run Marginal Cost and the wholesale price.

9.6 Interconnection assessment methodology

1. The tCSNP2 Refresh will incorporate input from FES that will include the generation plant ranking orders and demand forecasts across Europe for each FES scenario.
2. The FES make forecasts of the future interconnection capacities in GB, per scenario. The FES level of interconnection is calculated on a project-by-project basis, reviewing all axioms from economic, political, environmental etc. An important distinction between the FES and this process, therefore, is that the Interconnector Capacity Analysis aims to find what would be economically optimal rather than being based on specific projects.
3. This year's Interconnector Capacity Analysis will use an iterative optimisation for each scenario. The iterative optimisation approach attempts to maximise present value, equal to SEW less CAPEX less Attributable Constraint Costs (ACC), using a search strategy. The whole process is repeated four times to arrive at an optimal development of capacity in each of the four FES. Based on strong stakeholder feedback, there will be no Least Worst Regret calculation at the end of each iterative step, resulting in four optimal paths: one per FES and hence a range for the optimal solution will be produced. We will also undertake a regional analysis of the optimal location of new interconnection from a thermal and system operability perspective.
4. Timing of capacity increases can affect the SEW generated and Attributable Constraint Costs (ACC) by the interconnection across the study window. Within each search step, therefore, timing combinations will be considered. The use of spot years will be necessary to allow a solution to converge, wherein the commissioning of additional projects would be

evaluated only in a finite number of years. This means for each iteration, the welfare of the interconnectors in every spot year will be calculated.

5. In recent years the levels of interconnection within FES and Interconnector Capacity Analysis have started to converge. This is understandable as the FES scenarios are already partially optimised with respect to the levels of interconnection within each scenario. Each scenario within FES is modelled to ensure that a detailed within-day supply demand match can be achieved across all modelled years.

9.7 Options included in the assessment:

1. The assessment is limited to interconnection to GB. The level of interconnection between European markets will remain fixed throughout the scenarios (though could vary across future years). These levels are defined by the FES European scenarios.