Methodology for GB Commercial Arrangements relating to Interconnector Capacity Calculation

June 2023

1. Purpose

This document outlines the GB methodology for commercial arrangements for payments relating to interconnector (IC) capacity restrictions resulting from NTC restrictions set by ~~the~~ National Grid Electricity System Operator (~~NGESO~~ESO). The commercial arrangements in this document should be applied to:

- All interconnector projects (existing and future) that are connected to the GB transmission system.
- Capacity calculations made both before and after the Firmness Deadline.

This methodology should be applied in full to ensure consistency of NTC arrangements across all interconnectors.

A number of capitalised terms are defined in section 5 of this document.

2. Overview of Net Transfer Capacity (NTC)

What is an NTC? ~~are NTCs?~~

NTC or Net Transfer Capacity is a value used by System Operators (SOs) in order to ~~used in communicating~~ set~~ting~~ the maximum capacity that an interconnector can import and/or export to that SO's grid ~~carry~~ for a given Market Time Unit (MTU). The NTC process is ~~the~~a~~refore a~~ method of ~~determining~~calculating ~~and communicating~~ the resulting maximum import and export capacit~~ies~~y that an interconnector can ~~carry~~release to the market (Final NTC). The Final NTC, which~~is~~ is based on ~~multiple~~ the following inputs, is the lowest of any of these inputs and is calculated independently for each flow direction and MTU: ~~:~~ ~~:~~,

- ~~firstly~~Firstly, ~~by~~ the asset rating, condition and any relevant outages on the interconnector as determined by the ~~asset~~ interconnector owner ~~.~~i.e., the interconnector capability;
- ~~, but~~ Secondly, ~~it may also be set by~~ any restriction to the interconnector's capacity (NTC restriction) submitted by the System Operators (SOs) at each end of the interconnector, i.e. ~~the NGESO~~ESO ~~(~~or the ~~other c~~Connected~~ing Transmission~~ System Operator ~~(TSO))~~, based on the SO's respective ~~due to other~~ system conditions and possible security limitations required in order to maintain secure system operation (system security) ~~meaning that security is jeopardised~~.

Final NTC Calculation processes are carried out at ~~As part of the process to calculate capacity (the NTC process), NGNGESO may submit NTC limits for interconnector capacity in Day Ahead~~Day-ahead (DA) and ~~Intraday~~Intraday (ID) timeframes ~~into~~during which the interconnector owner can update its c~~C~~apability declaration and the connected SOs can submit or update their NTC restrictions, where operationally required, ~~before~~ ahead of the capacity ~~is~~ allocation

auctionsed. If NGESOESO has a requirement to restrict an interconnector's capacity and therefore submits an NTC restriction, sets an NTC limit lower than the capacity made available by the IC owner's Capability NTC or the Connecteding TSO's NTC restriction, this will result in a capacity restriction being applied (i.e. the NGESO NTC limit becomes the NTC restriction). Tthe resulting impact effect on the interconnector's capacity of the interconnector can be classified into four scenarioscapacity types; unallocated capacity, allocated capacity, nominated capacity and curtailed capacity. or unallocated capacity, which can be both restricted going into either the DA or ID auctions.

NB; the some interconnectors currently use InIntradayterconnector Trading/-Transfer Limits (ITLs) rather than NTCs. ITLs were the initial method to manage interconnector capacity and are subtly different to NTCs and no compensation is associated with this. ITLs only cover one quadrant of the NTC tool, which limits unallocated capacity and onlythat feeds into the ID auctions. They cannot restriction other forms of capacity and cannot be used at the DA timeframesscale. AlsoAlso, there is no compensation associated with the use of ITLs. ESO is working with the interconnector owners and Connected SOs still utilising ITLs to transition to the use of NTCs.

How does NGESOESO submit an NTC limitrestriction?

The processes relating to the submission of SOs' NTC restrictions and the calculation and application of Final NTCs, at each timeframe, for each interconnector are limits are submitted and applied as part of a trilaterally agreed NTCcapacity calculation process co-ordinating with both the interconnector owner and Cconnecteding TSOss. As noted above, three parties can submit NTC limits (NGESO, the interconnector owner and the connecting TSO); the lowest NTC limit for each Market Time Unit becomes the NTC restriction.

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3. Commercial Principles

Where NTC limits restrictions submitted by NGESOESO result in the iInterconnector capacity being restricted, NGESOESO will make compensation payments for the NTCsuch restriction. (noting that iIn certain circumstances, i.e. e.g.e.g., where the NTC restrictions result in additional income for the interconnector owner, the compensation payment instead? Flows will be from the interconnector owner to NGESOESO as per item (C) below). The GB commercial arrangements for payments for relating to (capacity limiting) NTCsNTC limitsrestrictions by ESO comply with the following principles:

(A) This methodology covers the commercial arrangements between the interconnector owner and National Grid Electricity System Operator (NGESOESO. It) and does not deal with the terms either between the interconnector owner and the holders of transmission capacity through the interconnector capacity auction processes or the other Cconnecteding TSO.

(B) To ensure cost neutrality, payments to an interconnector ownerss for reduction to:

- Allocated capacity should reflect the cost of to the interconnector of remunerating transmission capacity holders as set out in the relevant interconnector's Access Rules.
- Unallocated capacity should reflect the likely cost to the interconnector with the NTC limitrestriction applied, as compared to a scenario where the NTC restriction action to limit had not been takenapplied.

(B)(C) Any payments should recogniseconsider that an interconnector ownerss may generate additional income through a reduction in capacity (e.g.e.g., as capacity becomes scarce this may increase the price of capacity and congestion income may increase). They Payments should also take into account instances where an

interconnector owners receives congestion income. This may result in an interconnector owners paying, rather than receiving payments.;

(C)(D) Any payment must only cover the volume of reduced interconnector capacity being reducedresulting from the ESO's NTC limits restriction. set by NGESO at that time; e.g. No payment will be due if the capacity reduction is the result of any other factor, s outside the GB National Electricity Transmission System (NETS) (e.g. reduced availability of the interconnector circuits capability or NTC restrictions by the Connected SOconstraints in the connecting European grids by the other connecting TSOs, (unless concurrent in which case see point F). In the case of loss of access resulting from the interconnector's assets (such as a trip by the interconnector), there will be no further compensation to the interconnector owner via this mechanism.;

(D)(E) Ex-ante capacity reductions resulting from planned maintenance or works on the NETS shall not result in any compensation between the NGESOESO and the interconnector owner if the Bilateral Connection Agreement (BCA) for that interconnector describes a reduction of the Transmission Entry Capacity (TEC) for that specific planned outage condition.;

(E)(F) A reduction of capacity can only be paid once; should NTC limits restrictions by the two TSOs simultaneously result in an equal capacity reductionrestriction, in order to avoid a duplication in of compensation, the GB commercial arrangements shall cover half of the common shared NTC restrictionvalue with the other connecting TSO. Any additional capacity reduction beyond the shared NTC restrictioncommon value, will be wholly picked up by the respective connecting TSO. For example, if NGESOESO's NTC limits restriction reduces capacity by 100MW and the other cConnected ing TSO's reduces NTC restriction reduces capacity capacity by 125MW, the GB commercial arrangements shall be applicable to 50MW only (half of the common shared amount). Whereas, if NGESOESO's NTC restriction limit reduces capacity by 125MW and the other cConnected ing TSO's NTC restriction reduces capacity SO reduces capacity by 100MW, the GB commercial arrangement shall be applicable to 75MW (half of the shared amount plus all of the remaining unshared amount, i.e. (100/2)+25).

(F)(G) All parties (the interconnector owner, ESO and the Connected SO) will be responsible for ensuring that the working mechanism for calculating capacity ahead of allocation at the relevant timeframes is carried out as agreed. This can be achieved via any agreed party (or indeed a third party) fulfilling the calculating party role.

(G)(H) This methodology will be implemented via the necessary interconnector agreement changes to reflect the NTC calculation process in the operating protocols and relevant settlement agreements.

4. Principles of use

This section provides an understanding of the principles of when and how NTC limits restrictions arewill be applied by ESO. NTC limits restrictions are used as a last resort action to ensure secure system operation as a last resort action. Sometimes there are limited or unfeasible alternative tools available to relieve particularly constraints, potentially resulting in a need to use emergency tools, such as Emergency Assistance and Emergency Instruction, to avoid secure system operation being compromised.

1. The decision to calculate and possibly apply ~~and the Calculation of~~ NTC ~~limits~~restrictions will be based on:

   a. the best forecast of system conditions at the time;

   b. the best view of credible alternative actions that *are likely to* be available;

2. ~~, NGESO~~ESO will ~~only~~not submit DA NTC ~~limits~~ restrictions on a given IC where ID options* ~~do not exist~~are available. ~~,~~ This means either:

   - An established explicit ID market, where the throughput of energy volumes in the connecting market meets or exceeds that requested by ESO; or
   - Some other form of ID service provided by either the IC, connecting SO or another third party with reasonable availability and firmness.

   The exception to this is where a new ID market or service is formed, confidence and/or liquidity (~~i.e.~~i.e., is ESO able to secure the required volumes in the new market or service) would need to be built up before solely relying on this option in lieu of submitting DA NTC limits. ~~or; Once more is known regarding the impact of DA capacity restrictions on welfare**~~

~~2.~~3. ESO will seek to move the allocated flow to within securable limits via trading or other SO-SO trades;

~~3.~~4. ID NTC ~~limits~~ restrictions will be submitted:

   a. In case of further ID (re)nominations;

   b. In case ~~of NGESO~~ESO needs to secure market trad~~ed~~ing or SO-SO trade~~d~~s actions (securing against fail~~ed trades~~ for any reason).

5. Where multiple ICs jointly contribute/exacerbate a particular constraint, the ~~available capacity~~ total NTC restriction will be ~~shared~~ spread across the multiple ICs ~~equitably~~, as far as is practicable.

   - This requires a complex consideration of many elements, such as respective effectiveness of each IC to reduce a constraint and what initial nominations already exist. ~~, however the principle applied is that available capacity will be assigned proportionally.~~

~~4.~~6. ESO will submit a~~n~~ NTC restriction~~limitvalue~~ that allows maximum ~~capacity~~interconnector capacity, but which is consistent with secure system operation (system~~al~~ security);

7. Any DA NTC ~~limits~~ restriction~~s~~ which restricts the ~~that would restrict~~ nominated Long-Term capacity ~~will~~ should only be considered by the Calculating Party from the level of the nominated Long-Term capacity.

~~4. not be applied or executed~~

~~**this means either:*~~

~~– *an established explicit ID energy market, where the throughput of energy volumes in the connecting market meets or exceeds that requested by NGESO; or*~~

~~– *some other form of ID service provided by either the IC, connecting SO or another third party with reasonable availability and firmness*~~

~~***NGESO would publish this data and analysis when it is available.*~~

~~****This optimisation requires a complex consideration of many elements, such as respective effectiveness of each IC to reduce a constraint and what initial nominations already exist, however the principle applied is that available capacity will be assigned proportionally*~~

5. GB Commercial Arrangements Methodology

Applicable Terminology

Nominated

Capacity that has been sold by an interconnector in an auction at any timescales and declared in the latest Interconnector Schedule/Reference Programme (and Final Physical Notification in GB Balancing Mechanism). This is firm capacity.

N.B. – All LT Nominated capacity sold in Long-term auctions must be nominated prior to the DA auction in order to be firm.

Allocated

Capacityy~~y~~ that has been sold to market participants through auctions in any timescale and not yet lapsed, or capacity that that has been implicitly allocated as a result of an implicitly coupled auction (and therefore scheduled a flow). Different for long-term and ~~day-ahead~~Day-ahead/~~intraday~~Intraday:~~;~~

- Long-term (LT) – Capacity that has been reserved to market participants through the LT auctions but has not been nominated.
- ~~Day-ahead~~Day-ahead (DA)/~~Intraday~~Intraday (ID)– Same as Nominated above or capacity that that has been implicitly allocated as a result of an implicitly coupled DA/ID auction and therefore declared in the latest Interconnector Schedule/Reference Programme (and Final Physical Notification in GB Balancing Mechanism).

Unallocated

For DA capacity calculation, unallocated capacity is capacity that has not been sold within the interconnector's previous long-term auctions. For ID capacity calculation, unallocated capacity is capacity that remains unutilised (either not allocated, or not nominated for physical flow) following a Day-ahead explicit auction or Day-ahead implicit allocation process, that the interconnector~~,~~ proposes to make available for Intraday allocation. Different for LT, DA & ID:

- LT – Capacity that has not been sold i.e. not Nominated nor Allocated. Ahead of the first LT auction, no capacity has been Nominated or Allocated.
- DA – Capacity that has not been sold within the interconnector's LT auctions (excluding LT Allocated capacity which is classed as unallocated in DA unless nominated).
- ID – Capacity that remains unsold (neither allocated, nor nominated) following the Day-ahead or previous Intraday auction.

Implicit

Implicit allocation is in accordance with the market coupling mechanisms ~~in~~ at Day-ahead and/or Intraday timeframes where capacity is not bought directly but is implicitly bought with the energy product and therefore the flow is directly allocated (& nominated).

Explicit

Explicit allocation is where capacity rights are bought directly by parties and is then nominated afterwards to produce a flow (but nomination is not mandatory).

Firmness Deadline

The point in time after which cross-zonal capacity becomes firm for each interconnector, in accordance with their respective Access Rules i.e., the time at which the latest Interconnector Schedule/Reference Programme (and the associated FPN is submitted~~.~~).

Curtailment

When an NTC ~~limit~~ restriction results in allocated and/or~~&~~ nominated capacity being restricted in the final round of market activity (this is usually the ID phase), which therefore means curtailing the final nominated flow. This should only occur in a 'force majeure' or emergency situation as usually ~~NGESO~~ESO would counter-trade in order to move the scheduled flow below ~~any~~ the level of any ~~relevant~~ required NTC ~~limit~~restriction.

GB Commercial Methodology

Tables 1, 2 & 3 illustrate the GB commercial arrangements for each capacity regime on each bidding zone border and ~~for~~ where different categories of capacity restriction occur~~s~~.

These tables represent the different coupling arrangements that exist (or will exist) across GB borders ~~currently~~, and therefore each table references the relevant mechanism for clarity. The principles of the commercial methodology are consistent across the different coupling arrangements. This document will be updated when these arrangements change over time or as new ICs connect.

For a more in-depth explanation of the settlement methods in each box (labelled 1, 2, 3, 4a, 4b), please see Appendix 1.

Table 1: GB Commercial Arrangements matrix for explicit DA, and explicit ID

For example, IFA, BritNed, NEMO, IFA2, Elec~~L~~link and~~,~~ Viking Link

Timing of NTC & type of capacity affected	Restricted capacity that is allocated (but only unnominated ~~long term~~Long Term*)	Unallocated capacity restricted
Capacity management feeds into ~~Day Ahead~~Day-ahead auctions (i.e. before FD)	(1) See relevant Access Rules	(4a) Net capacity revenue loss/gain calculated from unrestricted marginal price (4b) For 0MW auctions; use the lower of the median or mean marginal price relating to the specific hour and direction for each of the previous 31 days.**~~the rolling monthly**, directional, hourly, median or mean (lower of) marginal pricequarterly calculated, directional, median or mean (lower of) marginal price~~
Capacity management feeds into ~~Intraday~~Intraday auctions (i.e. after FD, before ID auction opening)	(3) Net imbalance charge from both markets	(4a) Net capacity revenue loss/gain calculated from unrestricted marginal price (4b) For 0MW auctions; use the lower of the median or mean marginal price relating to the specific hour and direction for each of the previous 31 days.**~~For 0MW auctions; the rolling quarterly monthly**calculated, directional, hourly, median or mean (lower of) marginal price~~

**Any ~~long term~~Long Term capacity that is nominated is considered firm and will not be restricted – as per Principle of Use 7.*

*** Where 31 days of data are not available the number of days data that is available will be utilised. However in the the event that this is 0, then agreement will be reached with the affected Interconnector to utilise a number of days in*

the future.~~a month's worth of data is not yet available, settlement may be postponed at the request of the IC until sufficient data is available.~~

Table 2: GB Commercial Arrangements matrix for implicit ID

For example, Moyle~~, and~~ EWIC and Greenlink

Timing of NTC & type of capacity affected	Allocated capacity restricted	Unallocated capacity restricted
Capacity management feeds into Day-a ~~A~~head auctions (i.e. before FD)	N/A	N/A
Capacity management feeds into ~~Intraday~~Intraday auctions (i.e. after FD, before ID auction opening)	(3) Net imbalance charge from both markets	(2) Where practicable, the difference in congestion rent from a re-run of the coupling algorithm without restriction OR, the loss adjusted, market spread ~~adjusted for increased scarcity by 'correction factor'~~

Table 3: GB Commercial Arrangements matrix for implicit DA.

~~Interconnector Capacity Calculation~~ *For example, NSL*

Timing of NTC & type of capacity affected	Allocated capacity restricted	Unallocated capacity restricted
Capacity management feeds into ~~Day Ahead~~Day-ahead auctions (i.e. before FD)	N/A	(2) Where practicable, the difference in congestion rent from a re-run of the coupling algorithm without restriction OR, the loss adjusted, market spread ~~adjusted for increased scarcity by 'correction factor'~~
Capacity management feeds into ~~Intraday~~Intraday auctions (i.e. after FD, before ID auction opening)	N/A	N/A

6. Future Developments

- ~~**Correction Factor**: For implicit coupling where it is unpracticable to re-run the coupling algorithm, the loss adjusted spread and level of capacity restriction will be used to calculate a payment. This should ideally also include a simplified model of this relationship which includes a suitable 'correction factor' to account for the increased spread resulting from the increased scarcity. However due to a lack of available data this will be set to '1' or 100% for at least the first year (if this method is used) to allow for data collection and analysis before proposing a suitable correction factor model. The development of this correction factor will be shared with interested external parties should this route be taken.~~

- **ITL Transition:** Once this methodology has been approved, any ~~Where~~ existing interconnector agreements which ~~make reference to the term~~use ITL~~s, to be consistent with the wider terminology used, the term ITLs~~ will be ~~replaced as~~ changed to ~~NTC when updating relevant agreements~~ be consistent with this methodology. ~~Also,~~ The summarised differences between ITLs and NTCs are: a NTC restriction has the ability to curtail allocated and ~~some~~ nominated capacities as described previously in this methodology, whereas ITLs can only limit the unallocated capacity; and, there is no compensation associated with ITLs.

- **Trade and Co-operation Agreement Transition (TCA)**: NTC restrictions shall be used in parallel to the development of the Capacity Calculation arrangements envisaged within the TCA. This document shall be revisited, if needed, following the finalisation of the ~~Day Ahead~~Day-ahead and ~~Intraday~~Intraday Capacity Calculation technical procedure(s).~~s~~

- **Loose Volume Coupling:** As part of the TCA a new ~~Day Ahead~~Day-ahead auction is being developed. It is expected that this will result in a form of implicit coupling being implemented. As described above, for implicit auctions the best approach is to re-run the new algorithm, with and without NTC limits to determine if the interconnectors gain or lose congestion income. ~~. If this is considered too complicated the correction factor approach can be taken. This can be revisited once we understand the details of the new arrangements.~~

7. Settlement

Payments between the interconnectors and ~~NGESO~~ESO will only commence when there is an agreed bilateral agreement for this between the interconnector and ~~NGESO~~ESO, that is in line with the arrangements and principles within this document. The detail of the settlement and payment arrangements shall also be outlined in each party's bilateral agreements.

To support the invoicing arrangements, ~~NGESO~~ESO will collect the available data required to support the settlement of the commercial arrangements outlined in this document. Should the data not be able to be retrieved, interconnectors are requested to provide the data.

Please refer to Appendix 1 for details of settlement.

8. Implementation Method

Tripartite discussions between the interconnector, ~~NGESO~~ESO and the C~~o~~onnected ~~ing T~~SO shall be needed to include the relevant NTC processes in the trilateral Operating Protocol (OP).

In addition, the applicable interconnector specific settlement agreements shall be updated accordingly to align the processes outlined in the Operating Protocol.

Appendix 1 – Settlement

The Calculation Process

Considering the number of variables involved between interconnectors, auction regimes and various scenarios, calculating any settlement becomes complex. Below, ~~NGESO~~ESO outlines the process that will be undertaken to run this calculation. **For the avoidance of doubt, the formula set out below is illustrative and generalised for all interconnectors. The final formula will be set out and agreed in the trilateral interconnector settlement agreements.** Where necessary, sign convention may be reversed to indicate credit or debit payment direction.

Where restricted volumes are concerned, losses will be accounted for as appropriate~~,~~ according to each interconnector's Access Rules.

A. "Build the Picture"

Before calculating any settlement data, we must build the picture of the volume of each type of capacity ~~was~~ restricted at each horizon. This uses the **Auction Data, Interconnector Nominated Flow** and **Outages / Commercial Availability** sources detailed above.

With this data, we know the volume of unallocated and allocated capacity restricted through NTC ~~limits~~restrictions at both the DA and ~~Intraday~~ID stages, for each settlement period.

Data Sources Required

~~NGESO~~ESO and ~~Remote-End T~~Connected SO NTC restriction data

The first step is to ascertain what NTC restrictions ~~values~~ have been submitted ~~from~~ by both system operators. ~~-~~This data is provided either by the Final NTC Calculating party or by the interconnector owner (as detailed in the individual interconnector Operating Protocol and settlement agreement). ~~– RNP provides this data on some Interconnectors~~

Outages/Commercial Availability

To know how much capacity was restricted ~~from the~~through NTC ~~limits~~ restrictions~~being set~~, ~~we~~ ESO cannot assume the interconnector could have been available to run at maximum ~~flow~~ import/export – ~~we~~ ESO must account for this by considering the commercial availability/capability of the interconnector at the time of auction. ~~Our~~ ESO's initial approach has been to utilise Elexon's BM Reports/REMIT data, filtered as appropriate, to determine the maximum ~~capacity~~capability ~~flow~~ for the interconnector for each auction. For some interconnectors, this information is provided by the Final NTC Calculating party or by the interconnector owner.

- https://www.bmreports.com/bmrs/?q=remit provides a user interface for exporting data as needed. Elexon also has an API feature which can be used to fetch this data.

  ~~Elexon also has an API feature which can be used to fetch this data.~~

  ~~– RNP could prove an alternative source of this data for some interconnectors~~

Interconnector Nominated Flow

In order to distinguish what capacity was allocated, unallocated, nominated and unnominated across DA and ID ~~horizons~~timescales, the Total Nominated Flow is needed.

For DA Auctions:

- The nominated capacity is the sum of nominations made separately across import and export. This value can either be provided directly, or derived from the auction specifications (offered capacity) and the commercial availability/capability of the interconnector.
- ~~The unallocated capacity would be any capacity not sold across the relevant Long Term auctions. On IFA for example, % of capacity is reserved for Day-ahead auctions.~~
- The allocated but unnominated capacity can then either be calculated ~~either~~ as the difference between the two values above ~~values,~~ or fetched by assessing the volume of capacity sold across all Long Term auctions.

~~A similar process follows f~~For ~~intraday~~Intraday ~~NTC~~auctions, similarly to DA, ~~. T~~the exact source of this data may vary across interconnectors. As an example, NemoLink's nominations at Long Term, ~~Day Ahead~~Day-ahead and ~~Intraday~~Intraday are available on ENTSO-E's transparency platform - https://transparency.entsoe.eu/transmission-domain/r2/totalCapacityNominated/show.

B. Gather Commercial Data

The next step is to gather **Auction Data**, ~~**Day Ahead**~~**Day-ahead** **Prices** and **Imbalance/System Prices**, for each settlement period. ~~We~~ ESO can now calculate the ~~Day-Ahead~~Day-ahead spreads, the net imbalance costs, and ~~we can~~ recalculate explicit auction clearing prices. These calculations are explained in Step C.

C. Apply Settlement Formulae:

Depending on the interconnector's specific auction profile (see tables 1-3), different calculations apply for different types of capacity restrictions. These calculations are captured by 4 methods, labelled 1-4 in their respective tables.

(1) Allocated Capacity restricted before FD

See the relevant Access rules for the details of how capacity holders are remunerated. But for illustrative purposes an example calculation for explicit auctions will broadly be as follows:

$$Settlement_1 = P_{DACLEAR} \times V_{DAALLOCATED}$$

Where:

P^{DA}_{CLEAR} **= Clearing price of the ~~Day Ahead~~Day-ahead auction, where restricted capacity would have been sold.**

$V^{DA}_{ALLOCATED}$ **= The Volume of Allocated Capacity restricted through NTC restrictions.**

Data Sources Required

DA Prices:

The ~~Day Ahead~~Day-ahead Wholesale Price is needed in each relevant region to calculate the difference between them – the Day-ahead spread. A common data source for all regions should be used for ~~NGESO~~ESO's compensation calculation – ensuring the final settlement figure is fully cost-reflective and fair across parties. For ~~'remote end'~~ countries neighbouring GB, ENTSO-E serves as a common source for the DA Price. For GB, whilst single Intra-GB coupling is not in place, a volume-weighted average of the two hubs will be used.

- https://transparency.entsoe.eu/transmission-domain/r2/dayAheadPrices/show provides the user interface for exporting this data using ENTSO-E's transparency platform. ~~NGESO~~ESO will be using ENTSOE's API to automate the gathering of this data as needed.
- https://eu.data.energy/#eu provides EPEX ~~Day Ahead~~Day-ahead Price and Volume data (as well as some imbalance data covered below). This source requires paid membership.
- Market data | Nord Pool (nordpoolgroup.com)~~ttps://www.nordpoolgroup.com/historicall-arkett-ata//~~ provides historical data on N2EX ~~Day Ahead~~Day-ahead Prices and Volumes.

(2) Unallocated Capacity restricted, impacting an implicit auction

Any volume of capacity restricted under these conditions will be paid either according to the net loss/gain in congestion rent as determined by the coupling algorithm (Option 1) or the loss adjusted, scarcity corrected, ~~day-ahead~~Day-ahead market spread (Option 2).

Option 1 is the preferred option, but the feasibility of this is yet to be ascertained.

Option 1:

Here we re-run the implicit market coupling algorithm with the restriction removed. This provides a simulated congestion revenue, which can be calculated using the formula below.

$$Settlement_{2,\ OPTION\ 1} = (((P^{DA}_{GB,RERUN} \times R_{GBP\_EUR}) - P^{DA}_{RE,RERUN}) \times V^{DA}_{RERUN}) -$$

$$(((P^{DA}_{GB,ACT} \times R_{GBP\_EUR}) - P^{DA}_{RE,ACT}) \times V^{DA}_{ACT})$$

Where:

$P^{DA}_{GB,ACT}$ **= The Coupling Algorithm's "Live Outcome" DA Price in GB,**

R_{GBP_EUR} **= The exchange rate to convert GBP to EUR,**

$P^{DA}_{RE,ACT}$ **= The Coupling Algorithm's "Live Outcome" DA Price in the Remote-End region,**

$P^{DA}_{GB,RERUN}$ **= The Coupling Algorithm's "Rerun Outcome" DA Price in GB,**

$P^{DA}_{RE,RERUN}$ **= The Coupling Algorithm's "Rerun Outcome" DA Price in the Remote-End region,**

V^{DA}_{ACT} **= The Interconnector Flow determined by the Coupling Algorithm's "Live Outcome",**

V^{DA}_{RERUN} **= The Interconnector Flow determined by the Coupling Algorithm's "Rerun Outcome".**

$$P_{DAGB,LA} R_{GBP\_EUR} P_{DARE,LA} V_{DAUNALLOCATED} F_{CORRECTION}$$

Option 2:

Should access to the coupling algorithm prove impracticable, we will pursue the following method. The Loss-adjusted spread will be used to approximate a value of the capacity restricted by ~~NGESO~~ESO.

~~Data shows that the increased scarcity of capacity going into an implicit allocation process impacts on the prices in each relevant bidding zone, and hence the spread. To ensure the compensation is cost-reflective the raw spread is not enough on its own to calculate an appropriate payment. A simplified model can be constructed to account for this increased scarcity and spread and then a "correction factor" can be applied to represent this.~~

~~At present, quantitative figures are unavailable for constructing the model to determine the correction factor. Thus, if this calculation approach is used, it will be set at 1 (or a value that causes no effect mathematically) for the first 12 months of this methodology and revised once data is available for analysis.~~

~~Please refer to the Future Development section for more information.~~

Settlement$_{2,\ OPTION\ 2}$ **=** $((P_{DAGB,LA} \times R_{GBP\_EUR}) - P_{DARE,LA}) \times V_{DAUNALLOCATED}$ ~~$\times F_{CORRECTION}$~~

Where:

$P^{DA}_{GB,LA}$ **= The Loss Adjusted ~~Day Ahead~~Day-ahead Wholesale Price in GB (weighted between EPEX and NordPool),**

R_{GBP_EUR} **= The exchange rate to convert GBP to EUR,**

$P^{DA}_{RE,LA}$ **= The Loss Adjusted ~~Day Ahead~~Day-ahead Wholesale Price in the Remote-End region,**

$V^{DA}_{UNALLOCATED}$ = The Volume of Unallocated Capacity restricted through NTC restrictions

~~, $F_{CORRECTION}$ = The modelled correction factor.~~

~~$P_{DAGB,ACT} R_{GBP\_EUR} - P_{DARE,ACT} P_{DAGB,RERUN} P_{DARE,RERUN} V_{DAACT} V_{DARERUN}$~~

Data Sources Required

DA Prices:

The ~~Day Ahead~~Day-ahead Wholesale Price is needed in each relevant region to calculate the difference between them – the Day-a~~A~~head spread. A common data source for all regions should be used for ~~NGESO~~ESO's compensation calculation – ensuring the final settlement figure is fully cost-reflective and fair across parties. For ~~'remote-end'~~ countries neighbouring GB, ENTSO-E serves as a common source for the DA Price. For GB, whilst single Intra-GB coupling is not in place, a volume-weighted average of the two hubs will be used.

- https://transparency.entsoe.eu/transmission-domain/r2/dayAheadPrices/show provides the user interface for exporting this data using ENTSO-E's transparency platform. ~~NGESO~~ESO will be using ENTSOE's API to automate the gathering of this data as needed.

- https://eu.data.energy/#eu provides EPEX ~~Day Ahead~~Day-ahead Price and Volume data (as well as some imbalance data covered below). This source requires paid membership.

- Market data | Nord Pool (nordpoolgroup.com) ~~https://www.nordpoolgroup.com/historical-market-data/~~ provides historical data on N2EX ~~Day Ahead~~Day-ahead Prices and Volumes.

(3) Allocated Capacity restricted after FD

***Settlement*$_3$ = (P_{IMBGB} x $V_{IDALLOCATED}$ x S_{GB}) + (P_{IMBRE} x $V_{IDALLOCATED}$ x S_{RE})**

Where:

P^{IMB}_{GB} = The imbalance price in GB,

P^{IMB}_{RE} = The imbalance price in the Remote-End region,

$V^{ID}_{ALLOCATED}$ = The Volume of Allocated Capacity restricted through NTC restrictions,

S_{GB} = A binary value (either -1 or +1) to describe if the GB system was either in surplus or deficit,

S_{RE} = A binary value (either -1 or +1) to describe if the RE system was either in surplus or deficit.

Any volume of capacity restricted under these conditions will be paid such as to hold the relevant interconnector whole on imbalance, netted across both market zones. By doing this, ~~NGESO~~ESO holds the cost/risk for such restrictions.

Data Sources Required

Imbalance/System Prices and Volumes

There is no single source for System Prices across ~~europe~~Europe (ENTSO-E is inconsistent in this area). Some sources have been outlined:

- EnAppSys (https://eu.data.energy/#fr/elec/pricing) - FR, NO
- TenneT (https://www.tennet.org/english/operational_management/export_data.aspx) - NL
- Re.alto (https://portal.realto.io/browse-apis/elia-imbalance-data-be/details) - BE
- SEM-O (https://www.sem-o.com/market-data/dynamic-reports/#BM-026) - ISEM

(4) Unallocated Capacity restricted, impacting an explicit auction

a. Unrestricted vs restricted revenues

Restricting the capacity going into an explicit auction introduces scarcity in that auction. To compensate for these restrictions, ~~NGESO~~ESO will look to calculate the unrestricted clearing price – ~~NGESO~~ESO looks at answering the question "without the restriction, what would the auction have cleared at?"

The amount to be paid for capacity restricted under these conditions will be equal to the difference in the restricted and unrestricted auction revenue. It could be positive or negative – the settlement looks to hold the interconnector financially whole.

$$Settlement_{4a} = (P_{CLEARWITH\ NTC} \times V_{WITH\ NTC}) - (P_{CLEARWITHOUT\ NTC} \times V_{WITHOUT\ NTC})$$

Where:

$P^{CLEAR}_{WITH\ NTC}$ **= The Auction Clearing Price, when the NTC restriction is applied,**

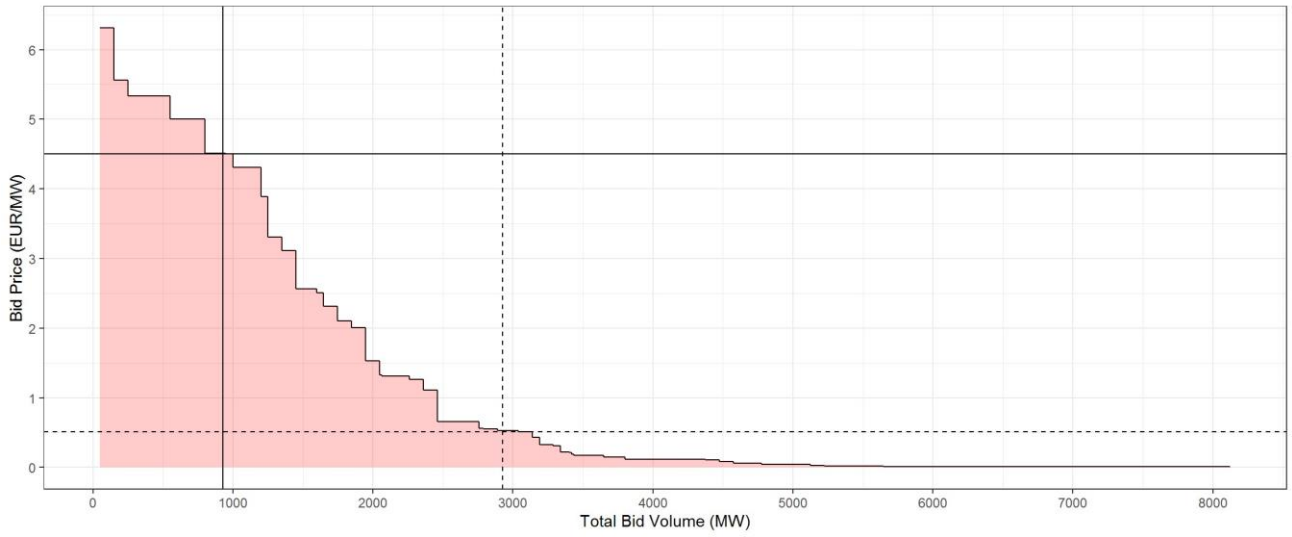
$P^{CLEAR}_{WITHOUT\ NTC}$ **= The Auction Clearing Price, when the NTC restriction is not applied,**

$V_{WITH\ NTC}$ = The volume of capacity allocated in the auction with the NTC restriction applied

$V_{WITHOUT\ NTC}$ = V_WITHOUT_NTC = The volume of capacity that would have been allocated if the NTC restriction had not been applied. This can be calculated as: =MINIMUM((Requested Capacity), (V_WITH_NTC+NTC Restriction))

This value is essentially the sum of $V_{WITH\ NTC}$ and the volume of capacity restricted due to the NTC restriction (calculated as part of "Build the Picture").

To further visualise this, please see the example plot below. This is an explicit auction bid ladder, with intercept lines to highlight volumes and clearing prices both with and without NTC restrictions.



b. 0MW auctions

Restrictions on capacity under these conditions may result in 0MW capacity being offered in the auction – in other words, the auction doesn't take place. ~~NGESO~~ESO will assess the historical clearing prices in both ~~the value and non-value~~

the import and export directions ~~(according to the relevant DA Price Spread),~~ for the relevant ~~each~~ hour of the day. ~~NGESO~~ESO will look at the previous 31 days ~~724 (31 days x 24 hours,)~~ auction datas~~,~~, and calculate both the median and mean clearing price. The lower of these two prices will be used to compensate restrictions of this type.

$$Settlement_{4b} = MINIMUM\ (\ MEAN(P^{CLEAR})\ ,\ MEDIAN(P^{CLEAR})\ )\ x\ \ V_{WITHOUT\ NTC}$$

Where:

P^{CLEAR} **= A list of monthly, hourly, directional ~~("value" and "non-value")~~ auction clearing prices,**

$V_{WITHOUT\ NTC}$ **= The volume of capacity that would have been sold, had no NTC restriction been applied.**

Data Sources Required

DA Prices:

The ~~Day Ahead~~Day-ahead Wholesale Price is needed in each relevant region to calculate the difference between them – the Day-a~~A~~head spread. A common data source for all regions should be used for ~~NGESO~~ESO's compensation calculation – ensuring the final settlement figure is fully cost-reflective and fair across parties. For ~~'remote-end'~~ countries neighbouring GB, ENTSO-E serves as a common source for the DA Price. For GB, whilst single Intra-GB coupling is not in place, a volume-weighted average of the two hubs will be used.

- https://transparency.entsoe.eu/transmission-domain/r2/dayAheadPrices/show provides the user interface for exporting this data using ENTSO-E's transparency platform. ~~NGESO~~ESO will be using ENTSOE's API to automate the gathering of this data as needed.
- https://eu.data.energy/#eu provides EPEX ~~Day Ahead~~Day-ahead Price and Volume data (as well as some imbalance data covered below). This source requires paid membership.
- Market data | Nord Pool (nordpoolgroup.com)~~https://www.nordpoolgroup.com/historical-market-data/~~ provides historical data on N2EX ~~Day Ahead~~Day-ahead Prices and Volumes.

Explicit Auction and Bid Data:

Auction specifications, bid ladders and results for explicit capacity auctions. The exact source of this data varies across each interconnector, but JAO serves as a publicly available example of the data, covering data for IFA, IFA2 and Nemo.

- https://www.jao.eu/main provides a user interface to export data manually from JAO. ~~NGESO~~ESO will be using JAO's new API tool to fetch this data automatically as needed.

D. Apply Cost-Sharing Principles

Once we have calculated the settlement figures for each box, for each settlement period, we must then consider Principle F – for each settlement period, what proportion of the total settlement figure is ~~NGESO~~ESO responsible for?

In practice this involves repeating the calculations in Step A, but calculating how much capacity was restricted individually by ~~NGESO~~ESO and the ~~RE~~ Connected ~~T~~SO, rather than just using the lower value.

Invoicing process

Monthly invoices will be produced by the party who is owed money based on the net value of transactions for the month. The invoice will be sent electronically in PDF format by email. The standard timescales shall be as follows or as otherwise detailed in respective settlement agreements:

- By the 8th business day from the 1st day of the month, the preliminary statement for the previous month shall be issued by ~~NGESO~~ESO to the interconnector.

  For example, by 10th June 2020, a preliminary statement will be issued for the NTC transactions which occurred between 1st May 2020 to 31st May 2020.

- Data shall be reviewed by the two parties between the issue of the preliminary statement and the issue of the invoice.

- By the 18th business day from the 1st day of the month, an invoice will be issued by the party who is owed money.

  For example, by 24th June 2020, an invoice will be issued.

- From 6 business days from the issue of the invoice, payment will be made.

  For example, the payment outlined on the invoice will be made from 2nd July 2020.

Currency

We will look to settle NTC restrictions in Euros where appropriate. It does not however make sense to convert GB imbalance costs from GBP to Euros for this purpose.

This will mean providing two monthly invoices:

1. Settlement for any incurred GB imbalance from formula 3, in GBP;
2. Settlement for all other compensation formulae, in EUR.