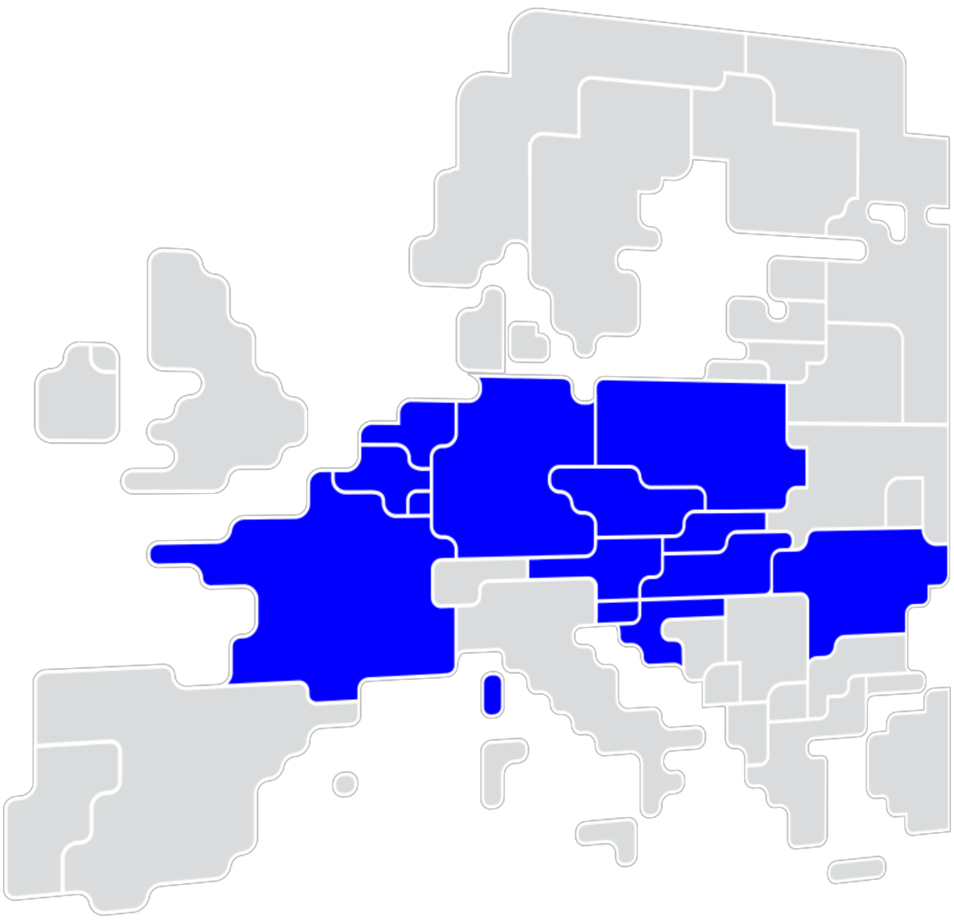
CORE

Explanatory document to the balancing timeframe capacity calculation methodology of the Core capacity calculation region in accordance with article 37(3) of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing

02 September 2022



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Content

Definitions

1. 'AAC' is the already allocated capacity which has been allocated as an outcome of the latest capacity calculation in the Core CCR;
2. ‘aFRR’ means automatic frequency restoration reserve
3. ‘AHC’ means the advanced hybrid coupling which is a solution to take fully into account the influences of the adjacent CCRs during the capacity allocation;
4. ‘annual report’ means the report issued on an annual basis by the CCC and the Core TSOs on the intraday capacity calculation;
5. ‘AOF’ means allocation optimisation function
6. ‘ATC’ means the available transmission capacity, which is the transmission capacity that remains available after the allocation procedure and which respects the physical conditions of the transmission system;
7. ‘Balancing Platforms’ means European platforms for the exchange of balancing energy from frequency restoration reserves with manual and automatic activation as well as from replacements reserves and the imbalancing netting process
8. BTCC means Balancing Timeframe Capacity Calculation
9. BTCC MTU is the balancing timeframe capacity calculation market time unit, which means the time unit for the intraday capacity calculation and is equal to 15 minutes;
10. ‘CBCL’ means cross-border capacity limits
11. ‘CCC’ means the coordinated capacity calculator, as defined in article 2(11) of the CACM Regulation, of the Core CCR, unless stated otherwise;
12. ‘CCR’ means the capacity calculation region as defined in article 2(3) of the CACM Regulation;
13. ‘CGM’ means the common grid model as defined in article 2(2) of the CACM Regulation and means the intraday CGM established in accordance with the CGMM;
14. ‘CGMM’ means the common grid model methodology, pursuant to article 17 of the CACM Regulation;
15. ‘CMM’ means capacity management module;
16. ‘CNE’ means a critical network element;
17. ‘CNEC’ means a CNE associated with a contingency used in capacity calculation. For the purpose of this methodology, the term CNEC also cover the case where a CNE is used in capacity calculation without a specified contingency;
18. ‘Core CCR’ means the Core capacity calculation region as established by the Determination of capacity calculation regions pursuant to article 15 of the CACM Regulation;
19. ‘Core net position’ means a net position of a bidding zone in Core CCR resulting from the allocation of cross-zonal capacities within the Core CCR;

20. Core TSOs are 50Hertz Transmission GmbH (“50Hertz”), Amprion GmbH (“Amprion”), Austrian Power Grid AG (“APG”), CREOS Luxembourg S.A. (“CREOS”), ČEPS, a.s. (“ČEPS”), Eles d.o.o. sistemski operater prenosnega elektroenergetskega omrežja (“ELES”), Elia System Operator S.A. (“ELIA”), Croatian Transmission System Operator Ltd. (HOPS d.o.o.) (“HOPS”), MAVIR Hungarian Independent Transmission Operator Company Ltd. (“MAVIR”), Polskie Sieci Elektroenergetyczne S.A. (“PSE”), RTE Réseau de transport d’électricité (“RTE”), Slovenská elektrizačná prenosová sústava, a.s. (“SEPS”), TenneT TSO GmbH (“TenneT GmbH”), TenneT TSO B.V. (“TenneT B.V.”), National Power Grid Company Transelectrica S.A. (“Transelectrica”), TransnetBW GmbH (“TransnetBW”);

21. ‘CROSA’ or ‘coordinated regional operational security assessment’ means a process of an operational process of an operational security analysis performed by RSC(s) in accordance with article 78 of the SO Regulation

22. ‘cross-zonal CNEC’ means a CNEC of which a CNE is located on the bidding zone border or connected in series to such network element transferring the same power (without considering the network losses);

23. ‘curative remedial action’ means a remedial action which is only applied after a given contingency occurs;

24. ‘CZCA’ means cross-zonal capacity allocations for the exchange of balancing capacity or sharing of reserves

25. ‘default flow-based parameters’ means the pre-coupling backup values calculated in situations when the intraday capacity calculation fails to provide the flow-based parameters in three or more consecutive hours. These flow-based parameters are based on previously calculated flow-based parameters;

26. ‘external constraint’ means a type of allocation constraint that limits the maximum import and/or export of a given bidding zone;

27. ‘$F_{0,all}$’ means the flow per CNEC in a situation without any commercial exchange between bidding zones within Continental Europe and between bidding zones within Continental Europe and bidding zones of other synchronous areas;

28. ‘F_i’ means the expected flow in commercial situation *i*;

29. ‘FB’ means flow-based;

30. ‘flow-based domain’ means a set of constraints that limit the cross-zonal capacity calculated with a flow-based approach;

31. ‘FRM’ or ‘FRM’ means the flow reliability margin, which is the reliability margin as defined in article 2(14) of the CACM Regulation applied to a CNE;

32. ‘F_{max}’ means the maximum admissible power flow;

33. ‘F_{ref}’ means the reference flow;

34. ‘$F_{ref,init}$’ means the reference flow calculated during the initial flow-based calculation;

35. ‘$F_0,Core$’ means the flow per CNEC in the situation without commercial exchanges within the Core CCR;

36. ‘GSK’ or ‘GSK’ means the generation shift key as defined in article 2(12) of the CACM Regulation;

37. ‘HVDC’ means a high voltage direct current network element;

38. ‘IDCC’ means the intraday capacity calculation process in Core CCR

39. ‘ID CC MTU’ is the intraday capacity calculation market time unit, which means the time unit for the intraday capacity calculation and is equal to 60 minutes;

40. ‘IDCZGCT’ means Intraday Cross Zonal Gate Closure Time and defines the end time of the ID market

41. ‘IGM’ means the intraday individual grid model as defined in article 2(1) of the CACM Regulation;

42. ‘IN’ means imbalance netting

43. ‘INPF’ means imbalance netting process function

44. ‘internal CNEC’ means a CNEC, which is not cross-zonal;

45. ‘I_{max}’ means the maximum admissible current;

46. ‘merging agent’ means an entity entrusted by the Core TSOs to perform the merging of individual grid models into a common grid model as referred to in article 20ff of the CGMM;

47. mFRR: manual frequency restoration reserve

48. ‘MNEC’ means a monitored network element with a contingency;

49. ‘NP’ or ‘NP’ means a net position of a bidding zone, which is the net value of generation and consumption in a bidding zone;

50. ‘NTC’ means Net Transfer Capacity

51. ‘oriented bidding zone border’ means a given direction of a bidding zone border (e.g. from Germany to France);

52. ‘pre-solved domain’ means the final set of binding constraints for capacity allocation after the pre-solving process;

53. ‘pre-solving process’ means the identification and removal of redundant constraints from the flow-based domain;

54. ‘preventive remedial action’ means a remedial action which is applied on the network before any contingency occurs;

55. ‘PTDF’ or ‘$PTDF$’ means a power transfer distribution factor;

56. ‘$\mathbf{PTDF}_{init}$’ means a matrix of power transfer distribution factors resulting from the initial flow-based calculation;

57. ‘$\mathbf{PTDF}_{f}$’ means a matrix of power transfer distribution factors describing the final flow-based domain;

58. ‘zone-to-slack $PTDF$’ means the PTDF of a commercial exchange between a bidding zone and the slack node;

59. ‘zone-to-zone $PTDF$’ means the PTDF of a commercial exchange between two bidding zones;

60. ‘node-to-slack $PTDF$’ means …

61. ‘quarterly report’ means a report on the intraday capacity calculation issued by the CCC and the Core TSOs on a quarterly basis;

62. ‘RA’ means a remedial action as defined in article 2(13) of the CACM Regulation;

63. ‘RAM’ or ‘RAM’ means a remaining available margin;

64. ‘reference net position or exchange’ means a position of a bidding zone or an exchange over HVDC interconnector assumed within the CGM;

65. ‘ROSC’ means Regional Operational Security Coordination within Core CCR

66. ‘RR’ means replacement reserve

67. ‘SIDC’ means the single intraday coupling;

68. ‘slack node’ means the single reference node used for determination of the PTDF matrix, i.e. shifting the power infeed of generators up results in absorption of the power shift in the slack node. A slack node remains constant for each ID CC MTU;

69. ‘SO Regulation’ means Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation;

70. ‘standard hybrid coupling’ means a solution to capture the influence of exchanges with non-Core bidding zones on CNECs that is not explicitly taken into account during the capacity allocation phase;

71. ‘U’ is the reference voltage;

72. the notation x denotes a scalar;

73. the notation $\vec{x}$ denotes a vector;

74. the notation $\mathbf{x}$ denotes a matrix.

1. INTRODUCTION

This document gives background information and rationale for the CCR Core proposal for a methodology to calculate cross-zonal capacities within the balancing timeframe, being developed in accordance with article 37(3) of the EB Regulation.

The Commission Regulation (EU) 2017/2015 establishing a guideline on electricity balancing (hereafter referred to as the ‘EB Regulation’) proposes the application of a cross zonal capacity calculation methodology within the balancing timeframe for the exchange of balancing energy and for operating the imbalance netting process (hereafter referred to as ‘BTCC’).

The EB regulations introduces the balancing capacity calculation method in article 37 (3) and foresees this CCR Capacity Calculation Methodology for the Balancing time frame to be submitted by the end of 2022.

Before this new methodology is implemented, left-over capacities after the intraday cross-zonal gate-closure time shall be used as described in Art 37(2).

The aim of this explanatory document is to provide additional information with regard to the BTCC and how the Core CCR will provide capacities for Balancing Energy/Platforms/Products.

For higher legibility the document is structured as follows:

- Chapter 1 and 2 give a general presentation of the EB-Regulation requirements and the balancing timeframe capacity calculation methodology including the approach for finalization of the methodology
- Chapter 3 describes the high-level business process of the balancing timeframe capacity calculation and shows interrelations to other methodologies and processes
- Chapter 4 introduces a comprehensive description of the balancing timeframe capacity calculation methodology, deliverables and timelines
- Chapter 5 is dedicated to the public consultation process for this BTCC methodology

1.1. Core TSO deliverable report

No later than 24 months after implementation of this BT CCM, Core TSOs shall provide a report to the Core NRAs in which detailed plans are described on how to conclude on the additional number of recomputations based on more recent forecasts of balancing timeframe capacities. The scope of this assessment is detailed in article 4. In addition, the Core TSO will investigate additional measures to increase capacities during the validation phase as described in article 15.

It should therefore be considered that this Explanatory Note describes the current status of the BT CCM (September 2022) for the intended go-live after ROSC v2, but will be amended according to the further developments and study.

2. EB REGULATION REQUIREMENTS FOR CROSS-ZONAL CAPACITY CALCULATION WITHIN THE BALANCING TIMEFRAME

article 37(3) of the EB Regulation enables all TSOs within the CCR Core to develop a proposal for a methodology for a capacity calculation methodology within the balancing timeframe for the exchange of balancing energy or for operating the imbalance netting process.

This section provides a summary of the general EB Regulation requirements for the BTCC.

2.1. Updating cross-zonal capacities for the balancing timeframe

In general, TSO should frequently update the cross-zonal capacities used for the balancing timeframe.

3. HIGH LEVEL BUSINESS PROCESS

The following section gives an overview of the main principles regarding the foreseen high-level business process.

The BTCC defines the balancing timeframe as the timeframe close to and in real-time in which TSOs take actions to achieve the frequency targets of the synchronous area, and the Frequency Restoration Control Error (FRCE) quality targets of the load frequency control (LFC) block immediately before real time to ensure security of supply.

Therefore, unlike in other timeframes, there is no opportunity to make amendments after the closure of the market e.g. no possibility of additional capacity increasing measures as the balancing timeframe is very close to real-time and almost no time is available to activate RAs. For the same reason, virtual capacities are not foreseen and need to be excluded for the capacity calculation within the balancing timeframe because of the short timeframe.

In addition, technical limitations and interrelations with other methodologies or processes are considered for BTCC to create an efficient and robust process.

3.1. Interactions with other methodologies

There are many interrelations with current and future process changes and milestones of ROSC, IDCC, balancing processes, Implementation of EB regulation Art. 40-42 and ID capacity allocation which are illustrated in the picture below.

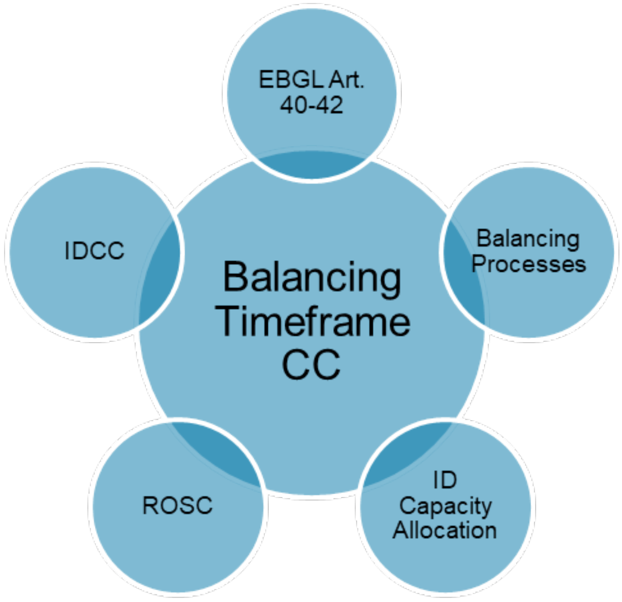


Figure 3-1: BTCC overview interrelations

3.1.1 Interaction with IDCC

- BTCC shall be consistent with the CZC calculation methodology applied in the ID time frame and thus defines the basic principles
- Cross-zonal capacity remaining after the intraday cross-zonal gate closure time (art 37.2) will be used for Balancing until BTCC is in operation
- Initially IDCC will provide NTCs for SIDC, this may change in the future
- Planned go-live in June 23 and the year after for the second IDCC computation

3.1.2 Interaction with ROSC

- The added value of the BTCC will be present, if more precise/secure/reliable input data (CGM) after DA or ID CROSAs will be available.
- 3 ID CROSAs will be introduced with ROSC V2.
- Process timings to be aligned
- Planned ROSC V2 go-live in June 2025

3.1.3 Interaction with other articles of EB regulation

- After implementation of EB regulation Art 40-42 reserved capacity for Balancing (CZCA) need to be considered during BTCC
- Capacity allocated due to Balancing Cooperation cannot be treated as schedules (No netting)

3.1.4 Interaction with SIDC

- SIDC provides already allocated capacity (AAC) after LT, DA and ID allocations

3.1.5 Interaction with balancing platforms

- TERRE (RR process), MARI (mFRR process), PICASSO (aFRR process) and IGCC (IN process) use the same Capacity Management Module (CMM)
- CMM and Balancing Projects to work together with the BTCC of all CCRs

- Harmonization over CCRs e.g., alignment on types of inputs, formats, timing is required
- Partly consumer-provider relation
- Set deadlines for input delivery T-42min (TERRE) and T-30min (MARI)

The figure below shows an overview of the planned CMM which manages the available capacities for various balancing processes (TERRE, MARI, PICASSO, IGCC).

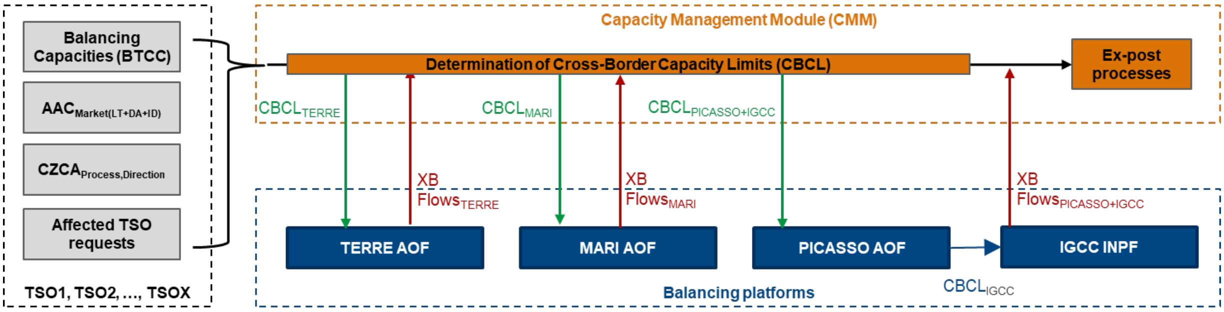


Figure 3-2: Overview Capacity Management Module

The BTCC process will deliver the cross-zonal capacities that can be allocated for the balancing processes. In addition, the CZCA (Cross Zonal Capacity Allocations – EB regulation article 40-42) allow a reservation of some capacities upfront which could be provided to the balancing platforms.

An assessment of the CZCA impact on all the Core processes is ongoing. This might impact the methodology at a later stage, which could trigger a review.

Flow-Based is currently not considered in any Balancing platforms or Capacity Management Module which require the calculation of NTC values.

3.2. Conceptual Approach

The conceptual approach for the balancing timeframe capacity calculation focus on robustness and integration into the current and future process landscape while providing maximum capacities to the balancing platforms.

Therefore, one of the main objective is to create synergies with the ROSC & IDCC implementation as much as possible to create a coherent process and sequential order as shown below.

Figure 3-3: Order of ROSC, IDCC and BTCC

Starting point for the whole process chain is the ROSC process that creates DA and ID grid models as output of the DA and ID CROSA processes. These grid models contain all agreed RAs (congestion free grid models) and build the basis for the FB computation of the ID capacity calculation process. Afterwards, when the ID market has closed, the capacities will be updated within BTCC using the latest results from market allocations.

With the introduction of BTCC, the following key process changes are planned and still need to be aligned in order to enable optimal efficiency:

- Increase of the overall number of FB computations on DACF and IDCF models from 2 to 4
    - Align timings with planned DA CROSA and 3 ID CROSAs
    - Update of ID CCM needed as only 2 FB computations are foreseen today
- Introduction of 96 dedicated ATC/NTC extractions within the balancing timeframe (every 15 minutes after each IDGCT)
    - Performed after each ID CZ GT to consider all market allocations before updating BT capacities
    - Independency of the number of FB re-computation as former ID FB parameters will be reused as starting point

The output of the 4 FB computation will be then used for the ID and BT process creating also potential benefits for the ID market as increasing the number of FB computations leads also to more frequent updates of ID capacity.

This approach is flexible as e.g. an increase of CROSA runs could also allow more updates of IDCC and BTCC, which results in the application of more recent grid models for both processes.

Streamlining and prioritizing the development in a way that is making sense is the main driver for this approach:

1. Ensuring that grid models are congestion free thanks to CROSA and thus create the optimal starting point for the capacity calculation
2. Offering this capacity to ID by increasing the frequency
3. Offering optimal capacities considering the latest market allocations within the balancing timeframe by better utilizing former calculated FB Domains

Thus, maximum efficiency can be created while offering optimal capacity and operational security. The high frequent ATC/NTC extraction is the best alternative to a FB allocation in Balancing as it takes into account the latest ID trades updates after ID GCT for each 15 min MTU.

This concept is chosen to consider some major technical limitations of a capacity calculation process close to real-time as that it is not possible to perform a FB computation on a grid model including all recent updates after the ID CZGCT:

- neither from input side, as updated grid models are not immediately available,
- nor from IT performance point of view, as the FB process cannot be performed in 18 minutes to meet the deadlines of the CMM (the 18 minutes is defined by the TERRE platform since the NTC and AAC should be provided to the CMM at t- 42min).

However, at a later stage, Core TSOs plan to investigate the added value of getting closer to real-time. Therefore, a study is foreseen as part of a TSO deliverable report.

4. DETAILED DESCRIPTION OF THE BTCC PROCESS

In this chapter the balancing timeframe capacity calculation process is described in more detail.

4.1. General BTCC calculation process

The basic principle of the BTCC process consists in re-using the latest IDCC outputs (ID FB domain) as the main input for BTCC. Increasing the number of FB computations in the future (expected from 2 to 4, which is still to be aligned with future amendments of ID CCM) will enable to have a FB computation after each DA/ID CROSA. That way, all agreed RAs are implemented leading to a congestion free grid model as starting point for all FB computations. The previous steps (retrieving secured grid models from ROSC CROSA, computing FB domain) are not properly run specifically for BTCC, but part of latest ROSC CROSA and IDCC processes. This is illustrated in the figure below.

Based on the latest ID capacities input, ATC extraction will be performed 96 times a day (for each MTU) in the balancing timeframe, taking into account the final AAC after IDCZGCT. That way, the most up to date information can be considered for balancing timeframe.

Despite the very limited time available before the capacity provision deadline (H-42min for TERRE, H-30min for MARI / PICASSO, while H-60 is the Intraday Cross-Zonal Gate Closure Time), the Core TSOs keep the possibility to update the capacities to assure grid security during the validation phase. This should be coordinated.

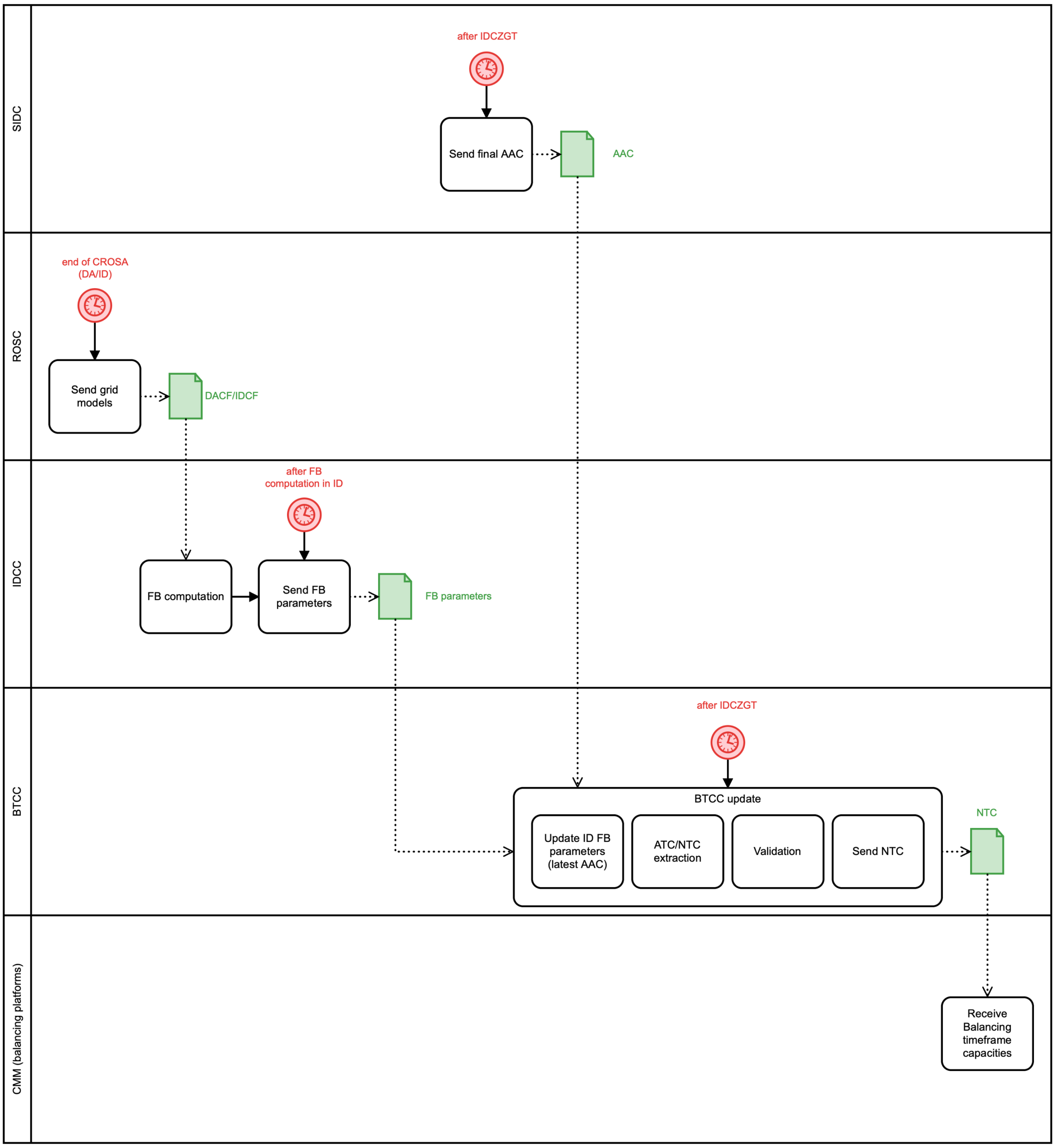


Figure 4-1: High level BTCC process

4.2. Inputs

The results of the latest IDCC process (FB computations) are supposed to be used as the basis for updating BT capacities. These Flow-Based domains should be built using the grid models available after each CROSA (1 DA CROSA and 3 ID CROSA grid models outputs).
The following paragraphs provides more details about the inputs used during the IDCC process that are the basis for the resulting FB domain computations used as inputs for BTCC. Such inputs are in general not properly handled in the BTCC process but in the latest IDCC one.

4.2.1 Methodology for operational limits

According to Article 5 of the proposal, Core TSOs shall use Critical Network Element as described in the IDCC methodology. Critical Network Element (CNE) is a network element, significantly impacted by Core

cross-border trades, which can be monitored under certain operational conditions. CNEs were formerly known as Critical Branches (CBs), while contingencies were called Critical Outages (COs). The combination of a CB and a CO (formerly CBCO) is referred to as a CNEC.
The CNECs (Critical Network Element and Contingencies) are determined by each Core TSO for its own network according to agreed rules.

The CNECs are defined by:

- A CNE: a tie-line, an internal line or a transformer, that is significantly impacted by cross-border exchanges;
- An "operational situation": normal (N) or contingency cases (N-1, N-2, busbar faults; depending on the TSO risk policies).

A contingency can be a trip of:

- a line, cable or transformer;
- a busbar;
- a generating unit;
- a (significant) load;
- A set of the aforementioned contingencies.

4.2.2 Maximum current on a Critical Branch (I_{max})

According to Article 6 of the proposal, the maximum admissible current ($I_{\max}$) is the physical limit of a CNE determined by each TSO in line with its operational security policy. This $I_{\max}$ is the same for all the CNECs referring to the same CNE. $I_{\max}$ is defined as a permanent or temporary physical (thermal) current limit of the CNE in kA. A temporary current limit means that an overload is only allowed for a certain finite duration (e.g. 115% of permanent physical limit can be accepted during 15 minutes). Each individual TSO is responsible for deciding, in line with their operational security policy, if a temporary limit can be used.

As the thermal limit and protection setting can vary in function of weather conditions, $I_{\max}$ is usually fixed per season. Its value can be adapted by the concerned TSO if a specific weather condition is forecasted to highly deviate from the seasonal values, e.g. when the forecasted ambient temperature significantly exceeds the temperature threshold that was used for determining the seasonal values. Insofar as dynamic line rating is available for a given CNE, its I_{max} may vary by market time unit depending on the weather forecast. There are also CNEs with fixed I_{max} for all market time units, for example because they are equipped with modern high temperature conductor material, whose current limit is less dependent on the ambient temperature than regular conductors, or because dynamic line rating is not yet available for this CNE.

4.2.3 Maximum admissible power flow (F_{max})

According to Article 6 of the proposal, F_{max} describes the maximum admissible power flow on a CNE in MW. This F_{max} is the same for all the CNECs referring to the same CNE. F_{max} will be calculated using reference voltages.

F_{max} is calculated from $I_{\max}$ by the given formula:

$$F_{max} = \sqrt{3} \cdot I_{max} \cdot U \cdot cos(\varphi)$$

Equation 1

with

F_{max}	maximum admissible power flow on a CNE in MW
$I_{\max}$	maximum admissible current in kA of the CNE
U	reference voltage in kV
$\cos(\varphi)$	power factor

4.2.4 Allocation constraints

Besides active power flow limits on CNEs, other specific limitations may be necessary to maintain the transmission system within operational security limits (e.g. voltage constraints, stability limits etc.) . Since such specific limitations cannot be efficiently transformed into maximum flows on individual CNEs, they are expressed as allocation constraints. More specifically, TSOs determine maximum import and/or export of bidding zones.

4.2.5 Reliability margin methodology

According to Article 8 of the proposal, the flow reliability margin (FRM) defines the methodology of determining the level of reliability margin per critical network element and contingency (CNEC).
FRM is based on the assessment of the uncertainties involved in the FB CC process, it shall cover the following forecast uncertainties of the Balancing Timeframe:

(a) cross-zonal exchanges on bidding zone borders outside the Core CCR;

(b) generation pattern including specific wind and solar generation forecast;

(c) generation shift key;

(d) load forecast;

(e) topology forecast;

(f) unintentional flow deviation due to frequency containment process; and

(g) flow-based capacity calculation assumptions including linearity and modelling of external (non-Core) TSOs' areas.

The Core TSOs shall aim at reducing uncertainties by studying and tackling the drivers of uncertainty.

4.2.6 Generation shift key methodology

According to Article 9 of the proposal, the generation shift key (GSK) defines how a change in net position is mapped to the generating units in a bidding zone. Therefore, it contains the relation between the change in net position of the bidding zone and the change in output of every generating units inside the same bidding zone.

Every TSO assesses a GSK for its control area taking into account the characteristics of its system. Individual *GSKs* can be merged if a bidding zone contains several control areas.
A GSK aims to deliver the best forecast of the impact on CNEs of a net position change, taking into account the operational feasibility of the reference production program, projected market impact on generation units and market/system risk assessment.

The GSK values are given in dimensionless units. For instance, a value of 0.05 for one unit means that 5 % of the change of the net position of the bidding zone will be realized by this unit. Technically, the GSK values are allocated to units in the CGM. In cases where a generation unit contained in the GSK is not directly connected to a node of the CGM (e.g. because it is connected to a voltage level not contained in the CGM), its share of the GSK can be allocated to one or more nodes of the CGM in order to appropriately model its technical impact on the transmission system.

4.2.7 Remedial actions in BT capacity calculation

Unlike in other timeframes, there is no opportunity to make amendments after the closure of the market e.g. no possibility of additional capacity increasing measures as the BT is very close to real-time and almost no time is available to activate RAs. That is why it is chosen to use IDCC and ROSC already agreed remedial actions during the DA and ID ROSC CROSAs processes as explained in the Article 10 of the proposal.

4.2.8 Power transfer distribution factors

The elements of the $\boldsymbol{PTDF}$ matrix represent the influence of a commercial exchange between bidding zones on power flows on the considered combinations of CNEs and contingencies. The calculation of the $PTDF$ matrix is performed on the basis of the CGM and the GSK.

The nodal $PTDFs$ are first calculated by subsequently varying the injection on each node of the CGM. For every single nodal variation, the effect on every CNE's or CNEC's loading is monitored and calculated[1] as a percentage (e.g. if an additional injection of a 100 MW has an effect of 10 MW on a CNEC, the nodal $PTDF$ is 10 %).

Then the $\boldsymbol{GSK}$ translates these nodal $\boldsymbol{PTDFs}$ (or node-to-slack $\boldsymbol{PTDFs}$) into zonal $\boldsymbol{PTDFs}$ (or zone-to-slack $\boldsymbol{PTDFs}$) as it converts the zonal variation into an increase of generation in specific nodes:

$$\boldsymbol{PTDF}_{zone-to-slack} = \boldsymbol{PTDF}_{node-to-slack} \cdot \boldsymbol{GSK}_{node-to-zone}$$

Equation 2

with

$\boldsymbol{PTDF}_{zone-to-slack}$	matrix of zone-to-slack $PTDFs$ (columns: bidding zones, rows: CNECs)
$\boldsymbol{PTDF}_{node-to-slack}$	Matrix of node-to-slack $PTDFs$ (columns: nodes, rows: CNECs)
$\boldsymbol{GSK}_{node-to-zone}$	Matrix containing the $GSKs$ of all bidding zones (columns: bidding zones, rows: nodes, sum of each column equal to one)

The $PTDFs$ characterize the linearization of the model. In the subsequent process steps, every change in net positions is translated into changes of the flows on the CNEs or CNECs with linear combinations of $PTDFs$. The net position (NP) is positive in export situations and negative in import situations. The Core NP of a bidding zone is the net position of this bidding zone with regards to the Core bidding zones.

1 In this load flow calculation the variation of the injection of the considered node is balanced by an inverse change of the injection at the slack node.

4.2.9 Reference flow (F_{ref})

The reference flow is the active power flow on a CNE or a CNEC based on the CGM. In case of a CNE, the F_{ref} is directly simulated from the CGM whereas in case of a CNEC, the F_{ref} is simulated with the specified contingency. F_{ref} can be either a positive or a negative value depending on the direction of the monitored CNE or CNEC

4.2.10 Remaining available margin (RAM)

According to Article 11 of the proposal, the remaining available margin of a CNE or a CNEC is the remaining capacity that can be given to the market taking into account the individual validation adjustment value. This final $\mathrm{RAM_f}$, is then calculated from the maximum admissible power flow $\mathrm{F_{max}}$, the reliability margin FRM, the active power flow on a CNEC $\mathrm{F_{ref}}$ and the individual validation adjustment value IVA (resulting of the individual validation) with the following equation:

$$\overrightarrow{RAM}_f = \vec{F}_{max} - \overrightarrow{FRM} - \vec{F}_{ref} - \overrightarrow{IVA}$$

Equation 2

With:

$\overrightarrow{RAM}_f$	Final remaining available margin
$\vec{F}_{max}$	Maximum active power flow pursuant to 4.2.3
$\overrightarrow{FRM}$	Flow reliability margin pursuant to 4.2.5
$\vec{F}_{ref}$	Active power flow on a CNE or a CNEC pursuant 4.2.9
$\overrightarrow{IVA}$	Individual validation adjustment

4.3. Description of the balancing timeframe capacity calculation process

The first step after receiving the latest AAC after ID CZGT is to update the RAM values of the flow-based parameters so that the latest allocations, that represent all energy trades allocated during the ID market, are taken into account.

Then, the same iterative approach as defined for the ID timeframe will be used to extract the available transfer capacities and thus gradually update the available capacities while respecting the constraints of the flow-based domain.

The iterative method consists mainly of the following actions for each iteration step k:

- Step one, for each CNEC and external constraint of the flow-based parameters the remaining available margin based on ATCs at iteration k-1 will be calculated

$$\overrightarrow{RAM}_{ATC}(k) = \overrightarrow{RAM}_{ATC}(0) - \mathbf{pPTDF}_{\boldsymbol{zone-to-zone}}\, \overrightarrow{ATC}_{k-1}$$

Equation 3

with

$\overrightarrow{RAM}_{ATC}(k)$	remaining available margin for ATC calculation at iteration k. $\overrightarrow{RAM}_{ATC}(0) = 0$ indicates the starting point.
$\overrightarrow{ATC}_{k-1}$	ATCs at iteration k-1
$\mathbf{pPTDF}_{\boldsymbol{zone-to-zone}}$	positive zone-to-zone power transfer distribution factor matrix

- For each CNEC, share $RAM_{ATC}(k)$ with equal shares among the Core oriented bidding zone borders with strictly positive zone-to-zone power transfer distribution factors on this CNEC;

- From those shares of $RAM_{ATC}(k)$, the maximum additional bilateral oriented exchanges are calculated by dividing the share of each Core oriented bidding zone border by the respective positive zone-to-zone PTDF.

- For each Core oriented bidding zone border, $\overrightarrow{ATC}_k$ is calculated by adding to $\overrightarrow{ATC}_{k-1}$ the minimum of all maximum additional bilateral oriented exchanges for this border obtained over all CNECs and external constraints as calculated in the previous step;

- Go back to step one;

Then, iterate until the difference between the sum of ATCs of iterations k and k-1 is smaller than 1kW.

Thereby, the consideration of already reserved capacities for the balancing timeframe or cross-zonal capacity allocations (CZCA) will be processed in accordance with the Core Intraday Capacity calculation methodology which concept will be described in more detail as part of one of the next ID methodologies amendments. An impact assessment on all Core CC timeframes processes is currently performed: the current BTCC design could potentially be impacted depending on the final global methodology.

Due to the increased number of ATC extractions, it is expected to better utilize the FB Domains and achieve more optimal capacities within the balancing timeframe.

The figures below highlight the differences between using the SIDC Leftover capacities and the updates according to the BTCC methodology on a situation that leads to block available capacities in certain directions in SIDC leftover.

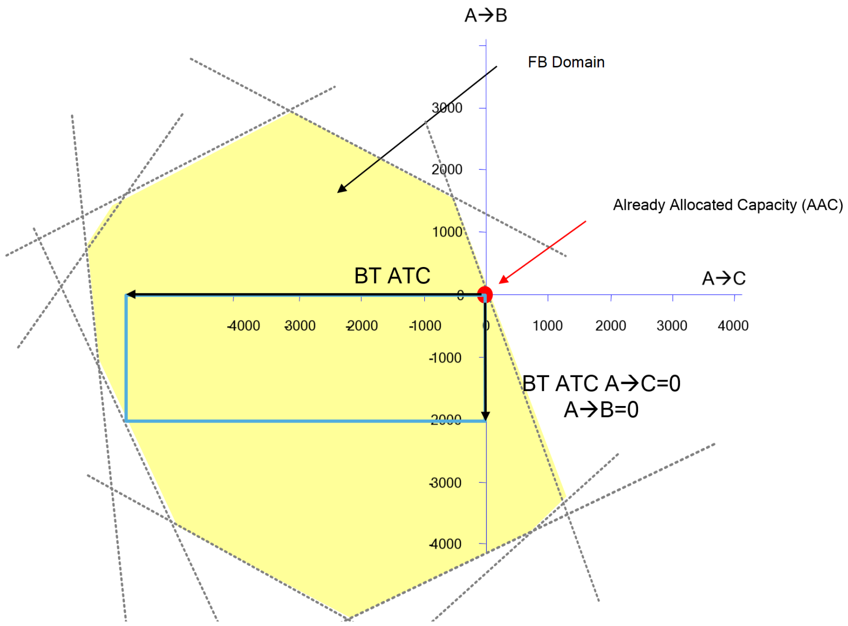


Figure 4-2: ATCs from IDCC (SIDC Leftover)

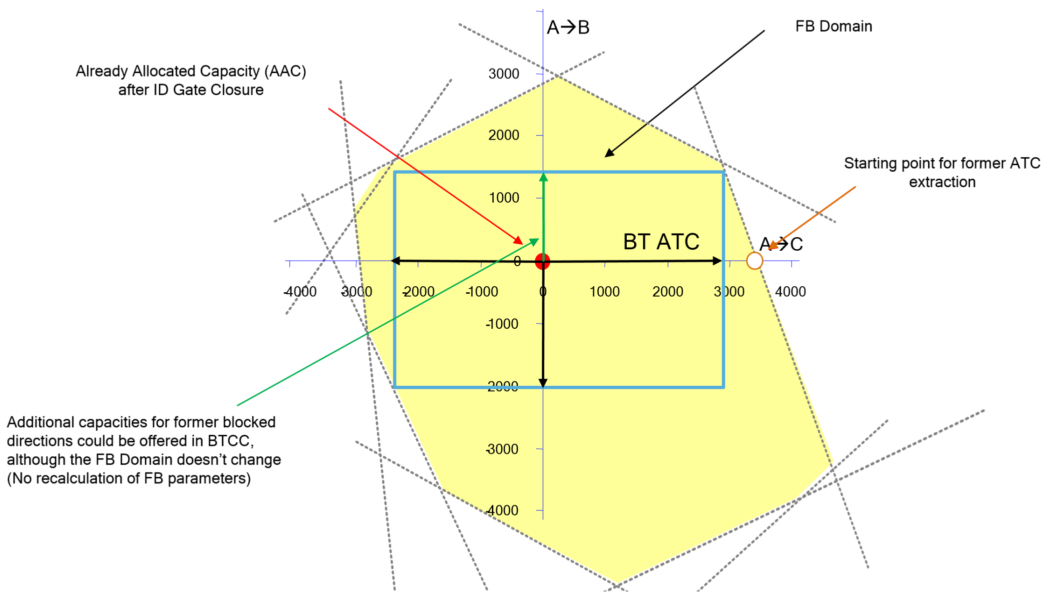


Figure 4-3: BTCC using a new ATC extraction for BTCC

Here, capacities for the former blocker direction (A to B) can be offered for the balancing timeframe solely due to the new ATC extraction, although the FB Domain didn't change. As this is done 96 times a day, after each IDCZGT, more capacities can be freed up and used for the balancing platforms, in particular for market directions that were fully used by the ID market.

Afterwards, the calculated ATC are converted to NTC by adding the AAC.

During the capacity calculation the Evolved Flow Based (EFB) methodology is used to model and allow efficiently allocation for cross-zonal capacities on HVDC interconnectors within Core CCR. Therefore, the influence of DC cable exchanges and ATC exchanges on the margins of the CNEs in the FB model are taken into account i.e. PTDFs need to be computed that reflect the impact of the ATC exchanges or DC cable exchanges on the margins of the FB constraints.

For modelling exchanges with connected (C)NTC regions, the impact of an exchange between both regions on the critical network elements with contingencies (CNECs) used by the FlowBased method offers two possibilities:

1. Standard Hybrid Coupling (SHC): the global impact of exchanges on interconnections between the Core CCR and the connected (C)NTC regions is taken into account by forecasting the expected exchanges over the interconnector.
2. Advanced Hybrid Coupling (AHC): the impact of the exchange on an interconnector between the Core CCR and the connected (C)NTC regions is modelled as an exchange between the Core bidding zone and a virtual bidding zone connected to the interconnector.

For BTCC it’s planned to use the same principles as for the IDCC methodology if applicable.

After the ATC/NTC extraction, Core TSO have the possibility to update and validate the capacities before provision to the balancing platforms. The objective of this process step is to ensure operational security in real-time. Therefore, each TSO can decrease capacities on its own borders after coordination with neighbouring TSOs. During the validation additional or more recent information can be considered.

In addition, it is proposed to further investigate the possibility to increase capacities during the validation phase if deemed necessary to maintain operational security as part of a deliverable report.

Finally, the capacities are sent to the Capacity Management Module for the balancing platforms where they are ready for allocation of balancing energy.

4.4. Transparency framework

The Core transparency framework used in the balancing timeframe capacity calculation is based on the current transparency framework of the Core intraday flow-based capacity calculation methodology. The intraday proven concept is further tailored to the specificities of the Core balancing timeframe capacity calculation methodology.

Final ATC/NTC cross zonal capacities for the for the exchange of balancing energy and for operating the imbalance netting process will be published for each market time unit of the business day on a dedicated online communication platform. In case of a fallback capacity calculation process is triggered, fallback ATC/NTC will be published instead.

4.5. Post go-live study

Core TSOs commit to perform a post go-live study to assess the benefits of increasing the frequency of Flow-Based computations based on more recent grid models forecast available. The analysis shall focus on the overall efficiency of such an implementation.

The final scope and objectives of the study phase will be aligned with the spirit of EB regulation articles 37 and 3 as mentioned in chapter 2.

Using more frequently and recent information could impact the forecast quality. However, the actual benefits or drawbacks in terms of grid security and capacities cannot be assessed at the moment, in particular due to the uncertainties regarding the impact of the upcoming operational processes as ROSC V1/V2 and IDCC.

An investigation based on actual-data from the upcoming processes is required as there is no certainty that the closer-to-real-time grid models created in between CROSA runs are congestion free and building an optimal basis for a capacity calculation process or leading to an enhancement of the operational security.

This study is one of the key stones of the proposed multi-step approach when aiming for an optimal solution for BTCC with using more improved forecasts while respecting technical limitations that prevents performing FB computations on grid models including all recent information after ID CZGCT in 18 minutes and its potential drawbacks.

The results of the study will be used to amend the proposed BTCC methodology in the future and define the final process for calculating capacities within the balancing timeframe.

4.6. Timescale and foreseen phases for implementation

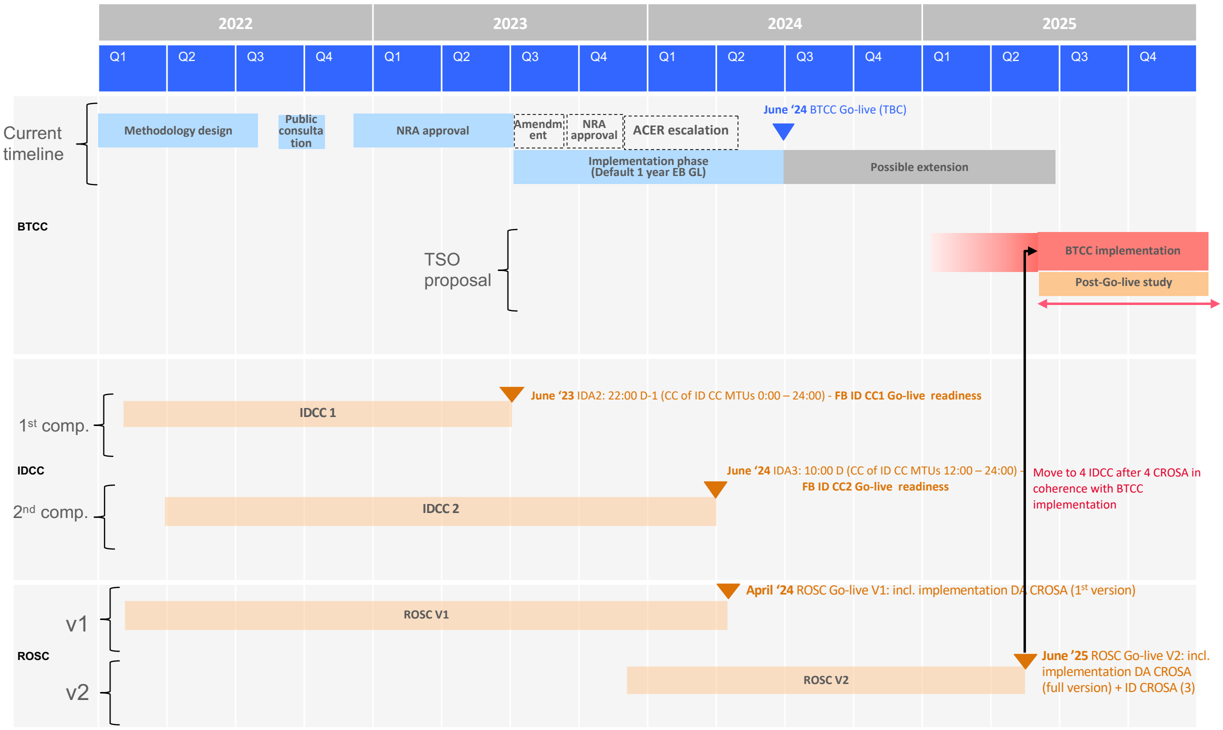
As depicted in the previous paragraph 3.2 and 4.5, the Core TSOs propose the following stepwise approach for implementation of a coherent, optimized, robust and safe BTCC process:

1. Increase of the overall number of FB computation on DACF and IDCF models from 2 to 4

2. Introduction of 96 dedicated ATC/NTC extractions within the balancing timeframe (for each MTU)

3. A post-go live study phase, which would focus on possible benefits of getting a process with higher frequency and closer to real-time input updates (FB domain computation).

The next figure highlights the dependencies of BTCC process with ROSC and IDCC. It is especially relevant to highlight that BTCC first step implementation (based on the aforementioned points 1 and 2) should take place after the implementation of ROSC version 2 go-live (implementation of 3 ID CROSAs) and the additional IDCC computations (2 to 4 FB computations):



4-4. Implementation timeline

The proposal is to rely on an implementation approach, which is feasible along with multiple parallel implementation streams (start small and iterate towards the end-goal: multi-step approach). The final scope would be clarified by a Post-go-live study once experience and data from IDCC / ROSC processes is available .

This proposal also fulfills the legal requirements of the EB regulation article 37 (updating capacities within the BT, consistency with IDCC, avoid market distortions) and is in line with the defined objectives in EB regulation article 3: apply the principle of optimization between the highest overall efficiency and *lowest total costs for all parties involved;* take into consideration agreed European standards and technical specifications.