Explanatory note for amendments to the Algorithm Methodology* for the price coupling algorithm due to Co-optimisation

Includes also explanation of amendment to:

Annex 2 to the Algorithm methodology: Set of requirements for the intraday auction algorithm.

- Amendments to the requirements for IDAs

Annex 3 to the Algorithm methodology - Algorithm monitoring for SDAC

- Monitoring of Scalable Complex Orders

Links on the referenced documents in this Explanatory note are provided in the "Useful links" section.

31 July 2023

Disclaimer

This explanatory document is submitted by all NEMOs to the Agency for the Cooperation of Energy Regulators for information and clarification purposes only accompanying the "All NEMOs' proposal for amendment of the Methodology for the price coupling algorithm, the continuous trading matching algorithm and the intraday auction algorithm also incorporation a common set of requirements in accordance with Article 37(5) of the Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management.

Contents

1. Introduction

This explanatory document gives a high-level overview of the background and context for All NEMOs proposed amendments to the Algorithm Methodology due to Co-optimisation.

A short resume of the legal background and the already, by ACER, decided Co-optimisation methodology as well as the Initial impact analysis and Roadmap study performed by TSOs and NEMOs, is given in the Background section.

The proposed amendments to the SDAC part of the algorithm methodology aims to include the high-level principals of Co-optimisation and the main elements that are needed for the implementation of the methodology for the allocation of capacity for the purpose of exchanging of balancing capacity or sharing of reserves as part of the SDAC process. Section 4 lists and further underpins the actual amendments and additions that are proposed in the different articles of the methodology and its annexes.

For a fully-fledged methodology for a subsequent implementation of co-optimisation into operation, far more research and development are required to be done by TSOs and NEMOs as explained in Section 3, where the considerations of the SDAC MSD working group are presented, and in Section 5 where NEMOs elaborate on the complexity of implementing Co-optimisation into SDAC, and the areas of uncertainty that will need further research.

In addition to amendments due to Co-optimisation NEMOs are also proposing amendments, due to the already implemented Scalable Complex Orders, to the Algorithm Monitoring Methodology. (Annex 3 to the Algorithm Methodology). These amendments are further elaborated in section 5.1.

For preparation of the upcoming Intraday Auctions (IDAs) certain amendments to Algorithm Methodology Article 6.2 and to the SIDC Requirements (Annex 2 to the Algorithm Methodology) are proposed. These amendments are further elaborated in section 5.2.

2. Background

2.1 The EB regulation

The Article 40 of EB Regulation lists Co-optimised allocation process as one of three alternative processes for two or more TSOs to exchange balancing capacity or sharing of reserves. A proposal for the application of Co-optimisation may be initiated by two or more TSOs or be requested by their relevant regulatory authorities in accordance with Article 37 of Directive 2009/72/EC. Co-optimisation shall apply for the exchange of balancing capacity or sharing of reserves with a contracting period of not more than one day and where the contracting is done not more than one day in advance of the provision of the balancing capacity.

2.2 The Co-optimisation methodology proposed by TSOs and decided by ACER

All TSOs submitted to ACER on 18 December 2019 a proposal for a methodology for a co-optimised allocation process of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves in accordance with Article 40(1) of the EB Regulation.

On 17 June 2020, ACER amended and decided – Decision No 12/2020 – on this methodology for co-optimised allocation process of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves in accordance with Article 40(1) of the EB Regulation. Article 3(1) of the co-optimisation methodology states that one principle for applying co-optimised cross-zonal capacity allocation is that the process shall be integrated within the SDAC algorithm and shall allocate cross-zonal capacities for the exchange of standard balancing capacity products or sharing of reserves following the objective in Article 9(2). The objective of the cross-zonal capacity allocation optimisation function shall be the maximization of the sum of economic surplus for SDAC and the economic surplus from the exchange of balancing capacity or sharing of reserves per trading day.

2.3 Entso-e's Implementation Impact Assessment

During the drafting of the Methodology for Co-optimised Allocation, the complexity of co-optimisation made clear that several market and process related aspects require deeper investigation. ACER therefore confirmed to let TSOs conduct an implementation impact assessment as part of the implementation phase in cooperation with the NEMOs. This report was published by all TSOs on 17 December 2021.

The report contains a Technical Feasibility analysis providing a detailed but high-level qualitative overview for the set of requirements for the implementation of co-optimisation. As the set of requirements will be provided by TSOs to NEMOs, the Implementation impact analysis recommended a prototype-based analysis of the identified implementation options before. Foreseen detailed requirements for a 2-step implementation and a 1-step implementation needed to be further assessed. It was also expected that such a prototype analysis provides detailed insights into the technically most favourable implementation approach. This could be a 'one-shot' 1-step co-optimisation implementation. It could also be a stepwise implementation starting with a hands-on 2-step co-optimisation implementation and a subsequent 1-step co-optimisation implementation. Therefore, it was recommended to conduct a prototype analysis which compared computational variants of a 1-step co-optimisation implementation option with 2-step co-optimisation implementation options and which facilitates the definition of the set of requirements.

2.4 TSO proposal on set of requirements

On 17 June 2022, in accordance with Article 8(2)(a) of the CACM, all TSOs sent a proposal for updating the Common set of requirements for the price coupling algorithm to include TSOs requirements as per Article 13(3) of ACER decision on methodology for a co-optimised allocation process for cross-zonal capacity for the exchange of balancing capacity or sharing of reserves.

2.5 The Co-optimisation Roadmap study

NEMOs and TSOs, within the framework of the MCSC, commissioned N-SIDE to perform a Co-optimisation roadmap study based on input from TSOs and NEMOs. The study was completed in May 2022 and made available to the public in February 2023.

2.6 ACER request for amendment of the SDAC algorithm methodology

On 25 November 2022, ACER requested by letter to All NEMOs to develop a proposal for amendment of the SDAC algorithm methodology in accordance with the TSOs' updated set of SDAC algorithm requirements from 17 June 2022, including any revisions thereof resulting from the approval of the HCZCA methodology, and submit it to ACER no later than 25 November 2023.

2.7 The methodology for harmonized allocation process for cross-zonal capacity

On 16 December 2022 All TSOs proposed a methodology for a harmonized allocation process of cross-zonal capacity for the exchange of Balancing capacity or sharing of reserves per timeframe in accordance with Article 38(3) of the EB Regulation. This methodology is currently in process for approval by ACER.

3. Co-optimisation

Article 40 of the EB Regulation considers the introduction of energy and reserve co-optimisation in the SDAC. Co-optimisation is an allocation process of CZC for the exchange of balancing capacity or sharing of reserves, and cross-border matching of the Day-ahead market bids. Co-optimisation requires the central optimisation of the allocation of CZC based on actual DAM bids and actual BCM bids.

In 2020, Entso-e launched two studies in relation to this aspect: one on the linking of bids in a co-optimisation setup and one on flow-based compatibility with co-optimisation.

- The purpose of bid linking in a co-optimisation of energy and reserve capacity context is to allow market participants to better express their technical and economic characteristics while being able to bid in both markets.
- As the level of activation of the TSO demand in real time is not known in advance, flow-based compatibility shall ensure that, for any activations of TSO demand lower than the TSO demands that are matched in balancing capacity market clearing, the network can support the resulting flows that are required for balancing this configuration of TSO demands.

NEMOs and TSOs commissioned in 2022 N-Side to perform a Co-optimisation roadmap study based on the Entso-e studies mentioned above and other input by TSOs and NEMOs. The main objective for the Co-optimisation study was to provide more insights into the implement ability of co-optimised allocation process of the balancing capacity market and day-ahead energy market, mainly comparing:

- 1-step vs. a 2-step implementation of co-optimised CZC allocation and
- multilateral vs. unilateral cross-product linking of bids between Balancing Capacity Markets (BCMs) and the Day Ahead Market (DAM).

This was the very first data-based study employing a potential combination of Cross-Zonal Capacity Allocation Optimisation Function (CZCAOF), Single Day-ahead Market Coupling (SDAC) and Capacity Procurement Optimisation Function (CPOF) under the conditions of co-optimised CZC allocation. The prototype study aimed to identify expected operational obstacles in terms of optimisation complexity and calculation time. As a quick and easy-to-implement approach N-SIDE enhanced Euphemia by expanding the existing SDAC optimisation algorithm by the co-optimised allocation requirements (CZCAOF & CPOF) for energy and balancing capacity.

The basic assumptions, as well as the scope, that were applied to the model in the prototype study are elaborated in the explanatory note to the Co-optimisation roadmap study.

The study produced a Euphemia Prototype for Co-optimisation, taking into account the flow-based compatibility deterministic requirement, which performs well with 60' MTU data and one additional BC product besides the DA. The simulations validate the proof-of-concept implementations of the scenarios in scope. Furthermore, they also show that the 1-step scenarios, compared to the 2-step scenario, avoid incoherent cross-zonal capacity allocations with respect to zonal price spreads, risks of infeasible second steps, and are also faster overall. On high-level, the scenarios can be simulated. This initial simulation still lacks key elements like the 15min MTU, multiple balancing market capacity products etc, and in general it is a simplification of the real market. Thus, prototype study was only a first preliminary exploration, also in the way it was designed, so the results cannot be used for any decision-making process before the simulation data and key assumptions brought up to date. There are still many design questions that need to be addressed.

3.1 Current concerns identified by SDAC MSD

It should be noted that the Roadmap study has several significant limitations. First, the assumptions and model specifications must be brought into perspective, as the prototype study applied some far-reaching simplifications. This includes for example the replacement of a procurement cost minimization approach by a welfare maximization approach (for balancing capacity market). As a consequence, it is obvious that not all requirements from the EB Regulation have been included in this prototype study, or the requirements have not been modelled in fully correct manner. The prototype is only capable to form prices based on welfare maximization which is not compliant to legislation. Therefore, the results of the prototype study cannot be considered as a starting point of any implementation effort, since the study does not offer sufficient ground for drawing any far-reaching conclusions. Any actual implementation steps, specifically any amendments to existing regulation and methodologies strictly require further analysis and a complete technical assessment.

When deploying the entire topology, functionalities of only a single balancing product were analysed out of total of six (6) products. The optimisation of bid linking across the balancing capacity products was not considered which will put more stress to the algorithm performance and is likely to seriously delay the market coupling calculation process. Because of this, required EB Regulation and Clean Energy Package requirements such as substitution of reserves could not be assessed.

Below are listed several concerns by NEMOs and TSOs that still needs further clarification for a future implementation of Co-optimisation:

- Unilateral bid linking option, this seems to come with down-sides and complexity. In the unilateral bid linking option, the balancing market is prioritised over the DAM.
- The basic principles of multilateral bid linking, and its complexity needs to be further investigated.
- The prototype only considers balancing capacity for mFRR up. The scalability of the co-optimisation for more than one balancing capacity product needs to be further evaluated.
- Use of different balancing capacity products in opposite ends of the bidding zone border needs to be defined.
- Interaction between co-optimisation and market-based CZC allocation method (EB Regulation 41(1)), where the procurement of balancing capacity happens based on actual balancing

capacity bids and forecasted DA energy bids (or, vice versa for the inverted market-based CZC allocation method).

- To be clarified: TSOs' requirement of deterministic compatibility with flow-based ensures that the network must cope with any configuration/uncertainty of TSO's balancing activations in real time. Even if the used method of "inscribed boxes" performs well in the assessed criteria (tractability, hub dependence, uniqueness of balancing capacity prices), the approach could be too conservative to allocate capacity for BC with negative effect on the efficiency of day-ahead energy market.
- General risk of conflict and incompatibility between co-optimisation requirements and current regulatory requirements.
- The simulations were done using 60 min MTU historical data. There are not any performance results reflecting the status with 15 min MTU data which would be essential as any potential implementation of co-optimisation would need to be done in a 15 min MTU framework.
- Impact of co-optimisation requirements (i.e. linking, one/multi steps, deterministic/probabilistic flowbased compatibility) on market results were outside the scope of technical assessment study. While apart from technical feasibility, each market design option can significantly change the outcomes of the markets (welfare, …).
- SDAC's current performance in terms of security, reliability and quality must always remain as top priority, when assessing implementation of new requirements as the co-optimisation. The prototype study did not investigate any of these aspects.
- In terms of prioritization of the workload of experts involved in SDAC & SIDC and current challenges of other projects planned to be implemented before co-optimisation (e.g IDA implementation, 15 min MTU implementation, Nordic FB, …). It is not certain that implementation of co-optimisation can be done in parallel to the other ongoing projects without putting them at risk.

It has been suggested by the algorithm supplier that many design questions should still be addressed before reaching a full set of requirement specifications. The following list includes a range of possibilities for next steps from the design perspective:

High level Design:

- Improved bid linking (advanced linking, unilateral bid linking design with multiple products, …)
- Incoherent prices due to sequential calculations
- The difference between optimisation of the Bid-cost minimization and Welfare maximization needs to be studied. Additional study item is Bid-cost minimization versus Marginal-price-cost minimization.
- Impact of flow netting (to identify conditions in which flow netting should be favoured or deactivated)

Detailed Design:

- Curtailment management
- Rounding procedures
- Ramping

4. Amendments to the Algorithm Methodology

4.1 Reference to regulation:

References to Article 40 of EB Regulation, as well as to the ACER decision 12/2020 on TSOS proposal for the methodology on Co-optimisation is added in the 'Whereas' section of the Algorithm Methodology. Reference to Article 40 of the EB Regulation is also made in the Article 1 – Subject matter and scope, and in Article 2 – Definitions and interpretations.

As the handling of Co-optimisation shall be implemented to the SDAC algorithm, a new point added to the 'Whereas' of the Algorithm methodology states that any reference to SDAC algorithm directs to the same algorithm solution used for the Co-optimised allocation of cross-zonal capacities for the exchange of balancing capacity or sharing of reserves. In consequence, the DA change control procedure, as related to the SDAC algorithm, applies also on co-optimisation.

4.2 The Price coupling algorithm with co-optimisation

Current Article 4 in the Algorithm Methodology describe the high-level requirements to the SDAC algorithm. A proposed new Article 4A incorporates also similar high-level requirements and features that shall be in place in the SDAC Algorithm for Co-optimisation.

Whether the MTU for balancing capacity will be the same as the MTU for Day-ahead is not concluded. According to standard balancing capacity products, different MTUs are possible. There may be a differentiation between SDAC MTU and BCM MTU. Set up of the products and their relation to time units need to be further elaborated in the next steps.

In the Balancing Capacity Market, there are Balancing Service providers (BSPs) offering balancing capacity to TSOs. Balancing Capacity is the capacity to regulate a unit – generation or consumption – up or down in order to balance supply and demand in the grid. A matching of the Balancing Capacity Order means that capacity has been procured by the TSO as a reserve potentially to be exchanged or shared.

4.3 Indication of a timeline

An anticipated timeline for a roadmap towards implementation of a fully-fledged methodology for Co-optimisation in the SDAC algorithm is also proposed under this new article 4A, in coordination with TSOs. The co-optimisation set of requirements for the price coupling algorithm amendments timeline and next steps, including research and development, is presented in the public consultation document with a deadline of 1 January 2029. In parallel to the public consultation, All TSOs will evaluate potential intermediate steps and the corresponding deadlines.

4.4 Corrective measures

There may be a set of products for the Balancing Market with co-optimisation that shall be handled by the SDAC algorithm. NEMOs propose under the new Article 12A to apply the same principles for these products as for the day-ahead products; the possibility to apply corrective measures in case the usage of certain balancing products cause degradation of the algorithm's performance.

4.5 Indicators for Algorithm Monitoring

With implementation of co-optimisation there will be additional need of monitoring. NEMOs are proposing additional indicators to be added to the Annex 3 to the Algorithm methodology: the Algorithm monitoring methodology for SDAC.

4.6 Update of the SDAC requirements

The TSO proposal for updating the Common set of requirements for the price coupling algorithm is added to the Annex 1 to the Algorithm methodology: the Common set of requirements for the price coupling algorithm.

5. Road map for implementation

These proposed amendments do not provide a fully-fledged Algorithm methodology on Co-optimisation.

The integration of the co-optimisation functionality cannot be ensured in the algorithm at this stage looking to the challenges SDAC faces already with current requirements and the requirements which are expected to come based on the roadmap. This concern applies to both algorithm performance and the workload of the SDAC MSD.

Prioritization of the regulatory development tasks is being discussed with ACER.

Co-optimisation is not yet part of the CACM regulation and there is no legally binding deadline for implementation of co-optimisation.

NEMOs and TSOs will not be able to comply with Section 2.2 of ACER's amendment request to carry out these R&D activities as early as 2023 because the SDAC R&D pipeline is fully booked until at least the end of 2025 by other projects with a legally binding deadline or already in progress. Thus, if this R&D for co-optimisation is carried out, MCSC would have to abandon R&D of other priority projects with a legally binding deadline, such as 15 Min MTU in SDAC. Moreover, depending on other priorities set by the EC and ACER, in collaboration with the NEMOs and TSOs, including the accession of Energy Community Countries, the pipeline will be full even longer.

There is a need for extensive R&D based on N-Side roadmap study. It is indicated in the Study that in total, from 1,5 to 2,5 years are expected to be needed to achieve a full implementation of co-optimisation on the SDAC algorithm.

In addition, there is still lack of proper input before R&D can start. It is necessary that market participants' (MPs) inputs are included in the form of a bidding guide, as this would result in a co-optimisation solution that is not only technically workable but also usable by market participants. There are two main reasons for including a bidding guide in R&D work:

1. NEMOs and TSOs need to know what is the right bidding structure from the MPs' point of view in order to offer them a co-optimisation function that satisfies the algorithm method modification requested by ACER and is useful to MPs.
2. NEMOs and TSOs may develop more than one co-optimisation solution, and they must evaluate which alternative is most beneficial to MPs regardless of all other requirements (e.g., welfare maximisation, algorithm performance, and robustness).

Interdependencies between legal requirements require a sequential implementation.

Finalizing implementation of other legal requirements is prerequisite for further R&D on co-optimisation as for the performance.

6. Other changes proposed

In addition to amendments due to Co-optimisation NEMOs are also proposing amendments, due to the already implemented Scalable Complex Orders, to the Algorithm Monitoring Methodology (Annex 3 to the Algorithm Methodology).

Also, for preparation of the upcoming Intraday Auctions (IDAs), certain amendments are needed.

6.1 Monitoring of Scalable Complex orders

The proposed amendments include changes to add the indicators regarding the Scalable Complex Orders (SCOs).

The “total number of SCOs”, “total number of matched SCOs” and “total matched volume from SCOs” indicators have been added. This inclusion shall provide transparency in the monitoring study of the CACM annual report, with the purpose of reflecting the transition from Complex Orders to Scalable Complex Orders.

The description of “number of PRMICs in the final solution”, “maximum delta MIC in the final solution”, “the PRMIC utility loss in the final solution” and “the volume of PRMICs in the final solution” indicators have been amended to include the scalable complex order contribution additionally to the contribution of complex orders. This is how the SDAC algorithm is implemented and it reports these values in the same approach followed for blocks, in which all order variants of the order type (simple blocks and complex blocks) are reported in the same indicator.

6.2 Requirements due to implementation of Intraday Auctions

In article 6.2 of the Algorithm Methodology; The proposed amendment regarding DA scheduled exchanges calculation includes a clarification that the deadlines set in DA SEC methodology are not applicable to IDAs – scheduled exchanges delivery after IDAs must occur within specific deadline after IDA gate closure time and not once a day as per DA SEC methodology. Operational deadlines are in this case captured by contracts among the TSOs and NEMOs.

Additional change is proposed in Annex 2 – ID requirements – where the obligation to allow partial coupling is captured. NEMOs and TSOs want to clarify that algorithm can allow this process within NTC domain however due to time restrictions and consequently impossibility to reopen the OBK the use of partial coupling in number of bidding zone is not considered appropriate and in interest of market participants. Moreover, not to endanger the process robustness within FB domain in the future when FB is implemented both in continuous allocation and IDAs, it is suggested to clarify that NEMOs operating in a Flow-Based domain are either all coupled or all decoupled from the session.

7. Useful links

"Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing – EB GL".
EUR-Lex - 32017R2195 - EN - EUR-Lex (europa.eu)

CACM
EUR-Lex - 02015R1222-20210315 - EN - EUR-Lex (europa.eu)

"All TSOs' proposal for a methodology for a co-optimised allocation process of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves in accordance with Article 40(1) of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing."
EB_GL_A40.1_191218_ALL TSOs_Co-optimised_CZC_allocation_Proposal (entsoe.eu)

"Methodology for a co-optimised allocation process of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves, in accordance with Article 40(1) of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing".
200617_A40(1)_ACER Decision on CO CZCA -Annex I.pdf (entsoe.eu)

"Implementation Impact Assessment for the Methodology for a Co-Optimised Allocation Process of CZC for the Exchange of Balancing Capacity or Sharing of Reserves. Entso-e – from all TSOs 17 December 2021".
Co-optimisation IIA Report (entsoe.eu)

"All TSOs proposal for updating the Common set of requirements for the price coupling algorithm".
220617_EB Regulation_Art.40(1)_DA_Requirements_COCZCA_Submission-to-NEMOs.pdf (entsoe.eu)

"MCSC – SDAC MSD: The Co-optimisation roadmap study".
co-optimisation-roadmap-study-.pdf (nemo-committee.eu)

"Methodology for a harmonized allocation process of CZC for the exchange of balancing capacity or sharing of reserves per timeframe. Entso-e 16 December 2022".
All TSO proposal: TSOs_HCZAM_Proposal.pdf (europa.eu)
Explanatory document to proposal: Explanatory document (europa.eu)

8. Abbreviations

AM – Algorithm Methodology

BC – Balancing Capacity

BCM – Balancing Capacity Market

BSP – Balancing Service Provider

CACM – Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on Capacity Allocation and Congestion Management (Capacity Allocation and Congestion Management)

CZC – Cross Zonal Capacity

DA – Day-ahead

DAM – Day Ahead Market

EB Regulation – Commission Regulation (EU) 2017/2195 of November 2017 establishing a guideline on electricity balancing (Electricity Balancing GuideLine)

EC – European Commission

HCZCA – Harmonized Cross-Zonal Capacity Allocation

IDA – Intraday Auction

MCSC – Market Coupling Steering Committee

MIC – Minimum Income Condition

MTU – Market Time Unit

NEMO – Nominated Electricity Market Operator

OBK – Orderbook

PRMIC – Paradoxically Rejected Minimum Income Condition

R&D – Research and Development

SCO – Scalable Complex Orders

SDAC – Single Day-Ahead Coupling

SDAC MSD – SDAC Market System Design working group

SEC – Scheduled Exchanges Calculation

TSO – Transmission System Operator