ACER
European Union Agency for the Cooperation of Energy Regulators

Evaluation report

Public consultations on the amendment of the algorithm methodology and on the expected benefits of co-optimisation

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PC_2024_E_04

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1. Introduction

On 25 November 2022, ACER requested NEMOs to propose amendments to the Algorithm methodology based on the TSOs' proposal for an updated common set of requirements, and to submit them to ACER by 25 November 2023.

On 24 November 2023, all NEMOs submitted to ACER their proposed amendments to the SDAC algorithm, based on the updated common set of requirements from the TSOs (Proposal).

Between 18 January and 20 February 2024, ACER publicly consulted on the Proposal.

Between 27 May and 19 June 2024, ACER publicly consulted on the Welfare Study (Welfare Benefits of Co-Optimising Energy and Reserves) commissioned by ACER. The study assesses the expected benefits from implementing co-optimisation in SDAC compared to the current market design and the (alternative) market-based allocation method.

In the first public consultation, launched on 18 January 2024, ACER asked for stakeholder input specifically regarding:

a) R&D activities to be performed by NEMOs and TSOs to enable the implementation of co-optimisation.

b) An appropriate bid design to allow market participants to bid in both day-ahead and balancing capacity markets.

c) The information required from market participants to define the bid design, the most suitable process for market participants to provide such information to NEMOs and TSOs and the required timeline.

d) Benefits of co-optimisation from market participants' perspective.

In the second public consultation, launched on 27 May 2024, ACER sought stakeholder feedback on the future direction of the R&D activities for a design where market participants are not required to forecast the day-ahead energy market outcome when bidding for balancing capacity.

ACER received 18 responses to the first public consultation and 24 responses to the second one. This document provides ACER's summary and evaluation of these responses.

2. Evaluation of responses

This section summarises all the respondents' comments and how these were considered by ACER. The tables below are organised according to the consultation questions and provide the respective views from the respondents, as well as a response from ACER clarifying how their comments were considered in the present Decision.

ACER would like to point out that for the sake of brevity and clarity of this document some arguments brought forward in the responses were summarised. ACER strove to respect the content of the responses provided, but to avoid any possible misunderstanding arising from summarising the observations received, the names of the respondents are not explicitly provided in the table below. For transparency reasons, the original and non-confidential responses to the public consultations, including the name of the stakeholder, are published here and here.

2.1 Public consultation on amending the electricity price coupling algorithm methodology

Topic 1: R&D activities

Respondents' views	ACER's views
1. Do you consider that the Proposal should take into account the steps listed under chapter 9 of the feasibility study when defining the R&D activities necessary to enable the implementation of co-optimisation?	
2 respondents answered "Yes". 8 respondents answered "Partially". 2 respondents answered "No".	
8 respondents affirm that the development of the high level and the detailed level design should be continuously reflected with market participants.	See section 6.2.2.2. of the Decision. ACER deems that the R&D phase must ensure sufficient involvement of market participants at key stages of the process. Involvement of market participants is encouraged in all phases of the R&D, but explicitly required when investigating bidding products and bidding formats, as these two areas are particularly relevant for them.
5 respondents argue that the timeline lacks a decision point to account for a potentially negative impact assessment and refraining from further implementation steps.	See section 6.2.2.3. of the Decision. ACER expects that the outcomes of the R&D work will provide sufficient information to determine the most appropriate approach to implement co-optimisation in the SDAC algorithm and to estimate the timeline for this implementation. ACER finds it is appropriate to first discuss the R&D outcomes with NEMOs and TSOs (and where appropriate with market participants), understand all the implications for the existing terms and conditions or methodologies (TCMs) before concluding on the best course of action regarding their amendments.
4 respondents do not see the research on co-optimisation as a priority and recommend focusing on projects already planned.	The outcome of the project prioritisation exercise carried out in the first half of 2024, available here, lists co-optimisation as a project with high

	priority. This is mainly based on the welfare benefits estimated by the consulting study procured by ACER. These benefits are assessed as being significant enough to merit at least further R&D on the introduction of co-optimisation in the day-ahead market.
3 respondents underline that it is of utmost importance that every step remains fully coordinated at the pan-European level.	ACER agrees. The process set out in the present Decision ensures this level of coordination.
1 respondent reckons that the time needed for R&D should be approximately 1.5 to 2 years. Another respondent considers ambitious to achieve a full implementation of co-optimisation in 1.5 to 2.5 years.	See section 6.2.2.2. of the Decision. The R&D timeline has been set based on the inputs provided by NEMOs and TSOs during the decision-making process.
1 respondent believes that the step-by-step approach suggested in the roadmap represents a realistic segmentation of the process and that the specific R&D activities listed under each step of the roadmap could significantly change during the process due to the evolutions of the price coupling algorithm.	ACER considers that the list of R&D focus areas mentioned in Article 4(15) of the main document may be complemented in the course of the R&D work based on the findings of these activities. ACER emphasises that the wording *"[…] all NEMOs, in cooperation with all TSOs, shall carry out R&D at least in the following areas*" reflects this intention.
2. Paragraph 4.3.2 of the explanatory note lists a set of design elements which, according to the NEMOs, would need to be further investigated before implementing co-optimisation. However, Article 4(16)(c) of the algorithm methodology includes other elements that are not mentioned in the explanatory note. **Do you consider that the Proposal includes all the necessary design elements requiring further R&D?**	
1 respondent answered "Yes". 10 respondents answered "No".	
In your view, what other elements should the Proposal consider?	
4 respondents claim that new simulations should be performed with data having 15-minute granularity. According to 3 respondents, these simulations should also consider multiple balancing capacity products.	ACER considers that a progressive increase in the complexity of the model for co-optimisation is foreseen in the R&D work. Additionally, ACER notes that point e) of Article 4(15) of the main document explicitly foresees research on the compatibility of co-optimisation requirements and functionalities with the existing ones.
1 respondent states that the aspects mentioned in the explanatory note should also be considered.	ACER agrees. ACER strove to make the list of R&D topics under Article 4(15) of the main document as comprehensive as possible.
1 respondent affirms the need to better understand the interplay with other markets	ACER considers that there is already now an interplay between balancing capacity

timeframes which are not addressed by co-optimisation (i.e., futures, intraday) to ensure that negative impacts on those markets are avoided and the needs of market participants are sufficiently addressed.	procurement (as done by TSOs) and other electricity market timeframes as these reserves are provided by the same market actors. The objective of co-optimisation is to integrate the balancing capacity procurement as efficiently as possible in the existing market sequence and hence making its effect more explicitly visible. As such, ACER considers that taking other market timeframes into account explicitly would not provide any additional insights.

Topic 2: Bid design and products

Respondents' views	ACER's views
3. When a market participant intends to bid in both day-ahead and balancing capacity markets, which bid design would you consider more appropriate?	
12 respondents answered "Separate bids for day-ahead and balancing capacity market(s)". 0 respondents answered "A single bid covering both day-ahead and balancing capacity market(s)".	
Please justify your answer and, in case of a single bid, please explain how the bid would allow to capture the interactions between the two markets.	
2 respondents deem that the information provided on the single bid option is not sufficient to evaluate it adequately. 1 respondent asks for a comprehensive consultation which investigates prerequisite and consequences of the single bid approach.	Additional information about the single bid option has been provided in the Welfare Study and its related public consultation, see section 2.2 below. ACER considers that an in-depth investigation of this approach needs to be carried out in the R&D phase.
2 respondents highlight the complexity of co-optimising heat and electricity production for thermal power plants, which cannot be captured with one single bid for day-ahead and balancing capacity.	ACER invites the concerned market participants to actively contribute to the R&D activities led by NEMOs and TSOs such that the specificities of this type of generation technology are duly considered in the analysis on the suitability of a single bid option.
1 respondent argues that the configuration with separate bids appears to be the natural choice since it seems more in line with the current market practices.	In ACER's view, the scope of the R&D activities should be holistic and not constrained by current practices.
4. In your view, what information would the NEMOs and the TSOs still need from market participants to define the bid design?	
4 respondents express the need for defining most parts of the design as close as possible to	ACER disagrees. As also stressed by NEMOs and TSOs in the last phases of the decision-

the actual date of implementation to ensure they remain up to date and adapted to the regulatory framework and to market participants' bidding strategies.	making process, product design, bid design and pricing mechanisms represent a fundamental step in the whole R&D process, which needs to be carried out as early as possible and upon which the other elements of the co-optimisation design will be assessed, including feasibility of implementation. The existing regulatory framework should not be considered as a constraint in the R&D phase since, as mentioned in section 6.2.2.3. of the Decision, at the end of the R&D activities further amendments to the Algorithm methodology and, if required, to the related TCMs will be assessed.
1 respondent claims that this question cannot be answered in isolation since the bid design should be part of the integrated R&D of the co-optimisation design.	As described in section 6.2.2.2. of the Decision, the integrated bid design will be part of the upcoming R&D activities.
1 respondent mentions interdependencies between the day ahead bid and the balancing capacity market bids.	ACER agrees that this represents a fundamental element of the first phase of R&D work and invites market participants to take an active role in the discussions led by NEMOs and TSOs on the bid and product design.
5. What is the most suitable process for market participants to provide such information?	
2 respondents answered "Public consultation". 0 respondents answered "Public workshop". 12 respondents answered "Other".	
6 respondents consider that market participants should be able to provide information both via public consultations and public workshops. 1 respondent also expects regular consultation of the EU associations representing market participants. 1 respondent suggests that the process should include a varied representation of different asset owners, portfolio compositions and sizes.	ACER agrees.
3 respondents affirm that the bidding topic is highly sensitive as it touches commercial information and hence it cannot be dealt with in a public manner. 6 respondents suggest bilateral exchanges to complement the public collection of information.	ACER acknowledges the sensitivity of the topic and agrees that bilateral interactions can facilitate the process. Further, stakeholders may use the option to provide confidential feedback to a public consultation since confidential information will not be published.

1 respondent deems that an expert group is needed, consisting of representatives from NEMOs, TSOs and market participants.	ACER considers that it is up to NEMOs and TSOs to assess the need for an ad-hoc expert group. ACER invites NEMOs and TSOs to keep all interested stakeholders regularly informed in the relevant fora about any developments in this regard.
6. Under Article 4(16) of the algorithm methodology, a 1-year timeline is foreseen for the collection of inputs from market participants on the bid design. How do you consider this 1-year timeline?	
8 respondents answered “Too short”. 4 respondents answered “Adequate”. 0 respondents answered “Too long”.	
4 respondents argue that these activities should only be started once the feasibility and welfare gains of co-optimisation are proven, including also an assessment of potential negative consequences. 3 respondents suggest initiating the process only once TSOs have expressed interest in deploying co-optimisation. 4 respondents argue that this process should only start once other projects with a higher priority have been delivered.	ACER notes that the Welfare Study identifies potentially significant welfare gains from the introduction of co-optimisation. These potential gains should be further investigated and carefully assessed in the R&D phase. Second, while the application of co-optimisation remains an option under the EB Regulation, it must be investigated whether the algorithm can support it and how. Without the necessary R&D and resulting potential changes to the algorithm, TSOs would not be able to apply co-optimisation if they decided to do so. The R&D work takes time and making it conditional on TSOs expressing interest in its application would mean that TSOs would not be able to effectively exercise their choice given to them under the EB Regulation. Finally, regarding the priority of projects, ACER recalls that outcome of the project prioritisation exercise carried out in the first half of 2024, available here, lists co-optimisation as a project with high priority.
1 respondent stresses that it is important to provide further clarity on the process in the Market European Stakeholder Committee (MESC) framework.	ACER agrees that MESC is one of the relevant fora where the process will be discussed with market participants.
7. With the introduction of co-optimisation, the list of products which can be taken into account in SDAC will need to be amended to include products related to balancing capacity and, potentially, products linking day-ahead and balancing capacity bids. **Which additional products would you consider necessary to be added to the list of SDAC products?**	

9 respondents consider that the structure of the products, for both energy and balancing, must allow market participants to communicate how the contracting of one product affects volumes and prices of the other products (multilateral linking across products and market time units).	ACER agrees that a product design which captures intertemporal and cross-product dependencies between SDAC and SPBC is one of the key elements of the R&D work. This is duly reflected in Article 4(15)(a) of the main document.
8 respondents argue that a co-optimised process must not lead to a reduction in the variety of energy products and bidding flexibility offered for the single day-ahead coupling.	ACER is of the opinion that a co-optimised allocation process must allow for sufficient products to effectively and efficiently address the needs of market participants.
2 respondents point to the need to focus on the further development of day-ahead and balancing capacity auctions and products, e.g. to fully enable the optimisation of flexible assets like storage.	ACER considers that this research direction is covered under Article 4(15)(a) of the main document.
1 respondent suggests that current situations or changes such as unavailability, curtailment management or changes in the bidding strategy would have to be communicated and processed simultaneously.	ACER invites the concerned market participant to provide additional details and reasoning for this suggestion in the upcoming interactions with NEMOs and TSOs on the topic.

Topic 3: Benefits of co-optimisation

Respondents' views	ACER's views
8. By allocating cross-zonal capacity where its market value is the highest, i.e. either to the day-ahead market or to the balancing capacity markets, co-optimisation aims to facilitate the integration of balancing capacity markets and to allow for a more optimal use of cross-zonal capacity between these two markets. Thanks to the co-optimisation process, the cost for the procurement of balancing capacity is expected to decrease by making use of cheaper bids from other areas and/or by reducing the individual TSO's demand for balancing capacity through sharing of reserves. **What do you consider to be the most significant benefits of co-optimisation?**	
3 respondents acknowledge the theoretical benefits of co-optimisation but highlight a few significant risks when it comes to its implementation.	ACER agrees. The potential risks, together with solutions to address or mitigate them, will be further assessed by NEMOs and TSOs in the upcoming R&D work.
2 respondents deem that the main benefits of co-optimisation would be that there is no longer a need to rely on market forecasts to make an optimal bidding strategy between balancing capacity and the day-ahead market. Hence, a	ACER agrees.

more optimal allocation between these markets can be achieved.	
1 respondent notes that co-optimisation can never achieve significant benefits if implemented on a step-by-step basis or only in some regions. Additionally, co-optimisation should work under a flow-based approach for the whole Europe.	ACER agrees that the 1-step approach, as one of the options considered in the implementation impact assessment (IIA) carried out by TSOs in 2021, represents the only way forward for any further assessment on the implementation of co-optimisation. The 2-step approach, which was also analysed in the IIA, should not be further pursued. Regarding the geographical scope covered by any potential application of co-optimisation, ACER agrees that the largest benefits could be achieved with a pan-EU coverage; nonetheless, the EB Regulation allows for narrower geographical scopes and ACER expects significant benefits also from regional applications. Finally, ACER expects that by the time co-optimisation may be implemented, any capacity calculation regions in the EU with relevant interdependencies of cross-zonal capacities operates under the flow-based approach.
1 respondent points to the forecast error as one of the main reasons for the high balancing capacity prices which occurred in many countries over the past years. Hence, it welcomes the implementation of co-optimisation as it introduces new opportunities for many market participants and in general makes wholesale markets more efficient, which can potentially decrease the cost of electricity for consumers.	ACER agrees on the expected increased efficiency and consequent reduction of costs for electricity consumers. About the impact of forecast errors on high balancing capacity prices, ACER agrees that forecast errors could have played a role; however, ACER reckons that other fundamental factors, including the energy crisis and the lack of cross-border cooperation for balancing capacity exchanges, have also played a fundamental role.
1 respondent considers the expected increase in liquidity in the balancing capacity markets as a potential benefit of co-optimisation, conditional to the absence of barriers to entry.	ACER agrees. The research activities on bid design and product design in the first phase of the R&D work should aim at identifying options which do not hamper participation to the balancing capacity markets.

Topic 4: Other remarks

Respondents' views	ACER's views
9. Please provide any other remarks on the Proposal.	

9 respondents argue that the increased complexity in the bidding process under co-optimisation may lead to a reduction of offered volumes and to the rise of risk premiums. In the extreme case, this could even force market participants to bid only in one of the two markets. This would likely imply a reduction of social welfare.	ACER acknowledges the potential risks and considers that solutions to address or mitigate them will be further assessed by NEMOs and TSOs in the upcoming R&D work.
7 respondents question the ability of the price coupling algorithm to allow for a full implementation of co-optimisation.	ACER stresses that such feasibility tests will be carried out throughout the R&D work. Article 4(15)(e) of the main document explicitly foresees research on the compatibility of co optimisation requirements and functionalities with the existing ones.
3 respondents point to a risk of decrease of transparency of market results under co-optimisation since it could be more difficult for market participants to understand the reasons behind accepted/not accepted bids, leading to unclear price signals.	ACER considers that the unavoidable complexity of the market coupling algorithm, even in the current situation, does not allow the results of the day-ahead auction to be easily re-calculated by interested stakeholders. At the same time, ACER does not believe that this should be an intrinsic goal of the process. Transparency of the results needs to be ensured with a sufficiently detailed public description of the functioning of the algorithm.
3 respondents advocate for the implementation of market-based allocation instead of co-optimisation. According to 1 respondent, the risks for delays are lower for a market-based allocation as it can be implemented separately from the single day-ahead coupling algorithm. Additionally, the experience from the Nordic aFRR capacity market is promising.	ACER agrees that the market-based approach allows to increase social welfare compared to a situation without any cross-zonal exchanges of balancing capacity. This is also reflected in the Welfare Study. ACER also agrees that the implementation of the market-based process presents less challenges compared to co-optimisation and welcomes any attempt to extend the application of this process beyond the regions where it is already operational or foreseen to be applied in the near future (i.e. the Nordic and the Baltic regions, respectively). Nonetheless, ACER believes that the expected benefits of a well-thought implementation of co-optimisation are higher compared to what can be achieved under a market-based allocation and hence requests, with the present Decision, NEMOs and TSOs to invest efforts in researching this alternative option.
2 respondents strongly oppose the limitation of portfolio-based bidding and see the possible	ACER considers that any potential implementation of co-optimisation would not imply the need to abandon portfolio-based bidding and to introduce unit-based bidding. If a

step towards unit-based bidding, which could come along with co-optimisation, very critical.	selection of a bid in the day-ahead market (currently) can be converted in a specific unit running, in co-optimisation the selection of the bid can result in a unit spinning or be available and a bid being provided to the balancing energy markets to determine its dispatch. Whether the bidding is done on a unit or portfolio level makes little difference.
2 respondents highlight the importance of developing fallback solutions before a potential implementation of co-optimisation. According to 1 respondent, the risk of decoupling increases with co-optimisation.	ACER highlights the importance of having a reliable process which minimises the occurrence of incidents in the operation of the algorithm. At the same time, ACER acknowledges that the back-up and fallback procedures will need to be amended to cope with the evolutions of the algorithm. A specific R&D item for this purpose has been included in Article 4(15) of the main document.
2 respondents consider that the welfare loss due to the restriction of intraday trading opportunities should also be studied.	Already during the elaboration of the EB Regulation, it was clarified that the balancing capacity market is primarily a market that runs in parallel with the day-ahead energy market and that it is primarily about finding an optimal solution in the day-ahead timeframe on the optimal selection of units providing either energy or reserves. Adjustments through the intraday timeframe should be possible in a similar fashion as today.
2 respondents emphasise the need to consider the costs of implementation and adaptation of operating systems and processes in the assessment of costs and benefits of co-optimisation.	ACER considers that the current legal and regulatory framework mandates the assessment of such costs only in very specific cases, e.g. a bidding zone review. While ACER acknowledges the financial impact that any potential implementation of co-optimisation might have on relevant stakeholders, ACER considers that these costs are one-off and that the expected benefits of co-optimisation are likely to outweigh them in a reasonable amount of time.
1 respondent expresses concerns on the applicability of the deterministic compatibility of flow-based approach heuristic to integrate the balancing capacity market into the flow-based calculation.	ACER highlights that the roadmap study concluded in 2022 provided some preliminary findings on this topic and that further investigations are needed. This research area is covered under Article 4(15)(e) of the main document.
1 respondent strongly opposes the reservation of cross-border capacity for balancing purposes and insists that all available cross-border	ACER considers that cross-zonal capacity should be allocated to the timeframes where its

capacity is given as soon as possible to the markets.	market value is the highest, not based on a chronological order.
1 respondent questions the added value of co-optimisation at the day-ahead timeframe since, like the status quo, it is still based on a forecast of the following day, which is imperfect.	ACER agrees that anything done before real-time is imperfect by definition. Nonetheless, the European electricity market design is structured around different timeframes for the delivery of electricity and any attempt to make each of them perform better should not be discarded based on such argument.

Annex I: List of respondents

No.	Organisation	Country
1.	BDEW	Germany
2.	CEZ	Czechia
3.	EDF	France
4.	Edison	Italy
5.	EnBW	Germany
6.	Energy Traders Europe	The Netherlands
7.	Engie	Belgium
8.	ENTSO-E	Belgium
9.	E.ON	Hungary
10.	Eurelectric	Belgium
11.	Europex	Belgium
12.	Green Power Denmark	Denmark
13.	IFIEC Europe	Belgium
14.	Illwerke	Austria
15.	Jamtkraft	Sweden
16.	Orsted	Denmark
17.	RAE	Greece
18.	RWE	Germany

2.2 Public consultation on the implementation of co-optimisation in the electricity day-ahead coupling algorithm

Respondents' views	ACER's views
1.1. The consultancy study shows significant welfare gains for co-optimisation under a design where market participants are not required to forecast the day-ahead energy market outcome when bidding for balancing capacity. As shown in Appendix G1, introducing an explicit price for balancing capacity, based on opportunity costs, leads to a deterioration of benefits of about 15%. In light of these findings, do you agree to further assess the bid design without an explicit price for balancing capacity in the upcoming R&D activities to be carried out by NEMOs and TSOs for the implementation of co-optimisation in the SDAC algorithm?	
2 respondents answered "Yes". 15 respondents answered "No".	
10 respondents believe that freedom of pricing should remain a cornerstone of the liberalized electricity markets.	ACER agrees. At the same time, ACER does not see any impairment of this freedom in either of the two bid designs since, even in case of integrated bids, the price for balancing capacity will be a direct consequence of the price for energy, which is explicitly set by the bidder.
8 respondents comment that balancing capacity bid prices should not be understood exclusively as a wish to integrate opportunity costs. Pricing balancing capacity integrates numerous other parameters including technical capabilities of assets as well as certain prerequisites for participating in the balancing market, e.g. balancing energy prices and probability of activations.	An underlying assumption in the study is that day-ahead market conditions should reflect expected real-time conditions, therefore intraday adjustments and the probability of activations in the balancing energy timeframe should not offer an additional expected revenue in a liquid market without arbitrage opportunities. Considering the above, ACER considers that the only fundamental cost driver for offering balancing capacity is given by the opportunity cost of not being cleared in the day-ahead energy market. Depending on the level of expressiveness of the bid design, the only cost component which might add to the opportunity cost could be given by some non-convex fixed costs which might or might not be covered by the balancing capacity price.
2 respondents note that a thorough analysis of multilateral linking is missing.	ACER points out that this is beyond the scope of the Welfare Study. NEMOs and TSOs will investigate this topic in the R&D work foreseen under Article 4(15) of the main document.

1 respondent doubts whether bids without an explicit price for balancing capacity are appropriate for storage and demand response resources.	ACER acknowledges the different cost drivers for storage and demand response resources and agrees that further investigations are needed to assess the suitability of this bid design option for these assets.
1 respondent argues that the Welfare Study does not indicate how the price formation process will be designed in a co-optimisation approach which would include the integrated bids design.	The price formation is dictated by the optimality conditions of the underlying market clearing model. These conditions are not explicitly stated in the study, but they are well-defined even if not explicitly listed in the report.
1 respondent considers that all the options for a bidding approach should be deeply investigated, first in terms of their impact on the market design and, only later, with respect to their impact on welfare gain and eventual feasibility.	ACER agrees with this approach and notes that it is fully aligned with the spirit behind the present Decision.
1.2. Please list advantages and disadvantages of a co-optimisation design where bids for balancing capacity are based on the price of the linked day-ahead energy bid and the day-ahead energy price calculated by the SDAC algorithm.	
The following **advantages** are mentioned: 10 respondents consider that the main advantage of the approach would be to externalise the bidding complexities for market participants posed by co-optimisation to a certain extent towards the market coupling algorithm and therefore reducing the risks for bidders.	ACER agrees.
4 respondents acknowledge the theoretical benefit of co-optimisation as a mean to be less sensitive to forecast quality of either market participants or TSOs in the definition of energy and reserve values, hence maximising social welfare and an efficient allocation of cross-zonal capacity.	ACER agrees.
4 respondents do not consider the avoidance of opportunity costs as an advantage solely attributable to the solution without explicit balancing capacity bidding. A co-optimisation design with explicit balancing capacity bidding should also relieve traders of having to bid unnecessary opportunity costs, if correct linking between day-ahead energy and balancing capacity bids is enabled.	ACER disagrees. Only in case of perfect foresight the two approaches would lead to the same outcome. In any other scenario, the explicit bidding of opportunity cost for balancing capacity would imply a deviation from the optimal solution.

1 respondent mentions mitigation of strategic bidding in balancing capacity markets, i.e. chance to incentivise cost-based bidding.	ACER agrees.
1 respondent indicates the integration of balancing capacity markets.	ACER agrees. ACER however notes that this benefit is independent on the choice of bid design.
1 respondent lists the facilitation of cheaper bids from elsewhere through sharing of reserves.	ACER agrees. ACER however notes that this benefit is independent on the choice of bid design.
1 respondent remarks addressing the misrepresentation of fixed costs in sequential designs.	ACER agrees. This is indeed the main advantage reported by the study.
The following **disadvantages** are mentioned: 15 respondents reckon that the study provides no clarity on the actual ability of the algorithm to deal with the complexity of co-optimisation without an increase of calculation time, increase of decoupling risk or reduction in optimality of the found solution. While this risk is indeed present in any design of co-optimisation, it would be exacerbated by integrating technical parameters and a unit-based configuration.	ACER argues that these elements are out of scope of the study. A more in-depth investigation is needed to assess all the implications of such a bid design. Such assessment is foreseen to be carried out by NEMOs and TSOs during the first part of the R&D activities pursuant to Article 4(16) of the main document.
10 respondents consider that allowing the abandonment of explicit pricing for balancing capacity in future R&D implies opening the possibility of abandoning portfolio-based bidding in the day-ahead market. 4 respondents consider it impossible to implicitly price balancing capacity based on the bids on the day-ahead market without doing so on a per-asset basis.	ACER disagrees that any potential implementation of co-optimisation implies the need to abandon portfolio-based bidding and introduce unit-based bidding. ACER however agrees that further research is needed, also based on inputs provided by market participants during the R&D phase, on which bid parameters and product design would be best suited for portfolio-based bidding.
8 respondents deem that converting day-ahead energy bids into pricing for balancing capacity bids also requires significant insight into the technical capabilities of the underlying assets and would thus require integration of a wide range of technical parameters into the day-ahead algorithm, possibly defining a type of integrated bid for each group of market participants.	ACER agrees that further investigation is needed to define which bid parameters are best suited for this approach. This assessment is foreseen to be carried out by NEMOs and TSOs during the first part of the R&D activities pursuant to Article 4(16) of the main document.
2 respondents believe that the linking of separate bids for energy and balancing capacity would enable the effective separation of the roles of BRPs and BSPs. It remains unclear how BSPs can participate to a market that provides	ACER deems that, under any bid design scenario, market participants should always be able to place a bid only for one type of market, i.e. energy or balancing capacity, should they

for only the integrated balancing capacity and energy bids.	wish to do so, independently on the label they get as market participant (BRP or BSP).
1 respondent indicates the risk of reducing balancing capacity markets' attractiveness for BSPs and the consequent decrease in market liquidity.	Co-optimisation has the potential to ease the access to balancing capacity markets and hence allow for improved liquidity. In such a case, an orderly price formation should sufficiently attract participation in balancing capacity markets.
1 respondent mentions that a direct interdependency between balancing capacity markets and day-ahead energy market by linked bids might have a disproportional impact on the day-ahead market. It is also unclear how fallback procedures can be arranged in a suitable way.	ACER highlights the importance of having a reliable process which minimises the occurrence of incidents in the operation of the algorithm. At the same time, ACER acknowledges that the back-up and fallback procedures will need to be amended to cope with the evolutions of the algorithm. A specific R&D item for this purpose has been included in Article 4(15) of the main document.
1 respondent notes that additional restrictions regarding the requirements for SPBC (e.g. full activation time) are possibly not sufficiently reflected.	ACER does not see a direct link between a bid design without an explicit price for balancing capacity and the inability to properly capture the technical requirements of the assets to provide balancing services. The study accounts for full activation times of different products. See equations E10 and E11 for the co-optimisation model and equations E30 and E31 for the sequential clearing models.
1 respondent claims an incompliance with the existing EB Regulation.	ACER notes this concern and would like to reassure that the introduced amendments have been thoroughly reviewed to ensure they align with the existing EU legal framework, including the EB Regulation. Nevertheless, we are open to continued dialogue and will assess any additional information or perspectives that stakeholders may wish to provide in this respect.
2. Please provide any other comments on the consultancy study.	
14 respondents find the study as highly theoretical. On some of the crucial challenges of co-optimisation, the study simply assumes the implementation of a solution without going into any details on whether such designs are feasible or what the reduction in welfare gain would be in case a degraded solution was implemented. Furthermore, the study does not provide sufficient basis to motivate any decision on product design, market design or methodology amendments since it is not based on	First, ACER considers that, while the study quantifies the benefits of co-optimisation under a given set of assumptions, the main objective of this study is to perform a proof-of-concept showing that co-optimisation does carry a significant potential to save costs at the EU level. Second, ACER deems that the methodology followed in the study is technically robust and based on state-of-the-art modelling of the day-ahead energy and balancing capacity markets. While some of the assumptions may

assumptions consistent with the operating principles of the day-ahead energy and balancing capacity markets. Nonetheless, according to 2 respondents, the study provides a good qualitative assessment.	not be aligned with the operating principles of the EU wholesale markets (e.g. unit-based bidding), they are considered standard practice in academic publications and are nonetheless necessary to achieve solid results compatibly with the availability of data.
12 respondents stress the need to analyse a more forward-looking system, given that energy storage assets are expected to play an important role for balancing capacity in the future. 5 respondents add that the study lacks focus also on demand response.	The study aims to assess the current power system, not to give a prognosis on how this will evolve in the future. Storage and demand response assets have not been modelled in the study due to lack of publicly available data and because expanding in this direction constitutes a topic that deserves a study on its own, which was not possible to perform within the allocated time and budget. It is important to note, however, that the potential for market power exploitation needs to be considered when analysing the role of these assets. Other studies on the topic show that storage assets are complex to coordinate in sequential designs. Although they can reduce the scope/role of fixed costs, they introduce serious coordination challenges because of heavy intertemporal linkages between market values, not just linkages between different products (energy and balancing capacity) in a single period.
7 respondents consider the methodological approach regarding the price forecast error as too simplistic. Market participants generally utilise more advanced forecasts than a simple 'last similar day' approach. 1 respondent considers that the estimated value of co-optimisation, as proposed by the study, is mainly linked to a potential error of market forecasts.	The data used by market participants for their forecasts is confidential, hence it is not possible to provide a calibration in this regard. When considering data for 2020, most of the data points are in a reasonable range. Some outliers have been considered to account for situations of forced outages, significant errors in weather forecast or analogous drivers. The study finds that fixed costs are the main driver of the welfare benefits, as they cannot be properly represented in status quo and market-based designs. The role of forecast errors is not prominent as they are found to alter the merit order curve only to a limited extent.
7 respondents claim that the role and value of intraday markets seem to be neglected in the study.	ACER reckons that the analysis is mindful of the possibility for market participants to correct their schedules and commercial positions after the day-ahead market clearing. As such, the intraday market can be seen as an 'adjustment market' and this the rationale behind referring to

1 respondent argues that the extent to which adjustments are considered in intraday is not clear. 2 respondents consider the assumption on the irrevocability of the dispatch decisions taken at the day-ahead stage as questionable. 2 respondents point to the relevance of the day-ahead market for the broader energy ecosystem, including long-term investments. 1 respondent suggests to also assess the impact on forward markets and financial transmission rights.	intraday adjustments in the report. This effect is captured by running the balancing market model run after the day-ahead one. The modelling methodology quantifies the effect of the irrevocable decisions taken at the day-ahead time stage, which include unit commitment decisions and dispatch setpoints of certain technologies. ACER considers that the real-time market clearing model that emerges from fixing these decisions mimics the real-time balancing energy market. As such, even if intraday markets are not explicitly simulated in the study, their effect is indirectly taken into account when running the real-time market clearing module. Regarding the relevance of the day-ahead market beyond the day-ahead stage, e.g. for investment decisions, forward markets and financial transmission rights, ACER believes that co-optimisation allows to send more accurate price signals compared to the sequential designs since it enables to assess the real market value of cross-zonal capacity.
6 respondents regret the short consultation period given to respond to the consultation. In their view, the reasoning that it is not the first consultation on the subject makes little sense, as it covers a whole new study, including a bidding approach that is introduced for the first time.	ACER always strives to allocate as much time as possible for public consultations and, more broadly, genuinely appreciates the possibility of further exchanges with interested stakeholders. At the same time, ACER notes that its decision-making processes are generally conducted under a very tight timeline, hence there is very limited room to extend the consultation period beyond what is initially communicated. ACER also points out that this public consultation and the corresponding Decision mark only the beginning of a more extensive engagement with market participants on the topic at hand according to the interactions foreseen during the R&D activities carried out by NEMOs and TSOs.
6 respondents question the linear programming approximation of the deterministic requirement.	ACER is not able to process this comment since no specific information on this concern nor alternative solutions on how to treat this requirement are provided.
5 respondents share concerns about the baseline against which the relative welfare gains are compared and to which degree the reduction	ACER reckons that section 3 of the study provides comprehensive and detailed explanations on the methodological approach followed for status quo, market-based and co-

in welfare in the day-ahead market is captured in the study.	optimisation. Regarding the welfare comparison, the study reports the welfare gains that are quantified by the sequence of day-ahead and balancing market clearing, along with the gains in the day-ahead market alone. The two results are reported in Figure 6. It is not possible to decompose welfare contributions between the energy and balancing capacity markets. The methodology in the study quantifies the economic cost of delivering both, because some cost components (such as fixed costs) cannot be decoupled between energy and balancing capacity. This is anyway one of the major motivations of co-optimisation.
5 respondents claim that the expected annual savings lack a clear comparison to the costs of implementation. Stakeholders must adjust IT systems, operational processes and contractual agreements.	ACER considers that the current legal and regulatory framework mandates the assessment of such costs only in very specific cases, e.g. a bidding zone review. While ACER acknowledges the financial impact that any potential implementation of co-optimisation might have on relevant stakeholders, ACER considers that these costs are one-off and that the expected benefits of co-optimisation are likely to outweigh them in a reasonable amount of time.
5 respondents reckon that the methodology used for the extrapolation of welfare gains from the Core region to the whole EU is questionable given the significant differences between e.g. Nordics and continental Europe.	ACER acknowledges the limitations of the approach taken for this extrapolation. Nonetheless, ACER believes that any other approach would suffer from a certain degree of arbitrariness and that it is not possible to infer the level of (in)accuracy without extending the model to the whole of Europe, which was not feasible in the amount of time allocated to the study.
4 respondents point to the risk of increase of paradoxical market results. 2 respondents also mention the risk of an increase in the number of decoupling cases.	The study is transparent about the fact that it does not account for paradoxical pricing related to non-convexities, see page 19 in section 3.4 of the report. Instead, the study assumes that the market clears to maximise economic welfare (which is standard practice in numerous worldwide markets) and assumes integer programming prices. Although this may lead to paradoxical market results, any other pricing method would also lead to paradoxical results, and this anyway does not affect the assessment of welfare gains but rather how this welfare is distributed between market participants.

	Regarding the risk of increase in the number of decoupling cases, ACER highlights the importance of having a reliable process which minimises the occurrence of incidents in the operation of the algorithm. At the same time, ACER acknowledges that the back-up and fallback procedures will need to be amended to cope with the evolutions of the algorithm. A specific R&D item for this purpose has been included in Article 4(15) of the main document.
3 respondents argue that the savings reported in the study are minor compared to the welfare gains generated by the market coupling algorithm.	ACER observes that there are two different levels of welfare in this discussion, which need to be clearly distinguished. On the one hand, the value of the electricity trade, i.e. a price multiplied by a cross-zonal flow; on the other hand, the efficiency gain which represents the additional cost reduction of using resources more efficiently. ACER invites the concerned respondents to reassess their claims based on figures which concern reduction of costs instead of values of trades.
3 respondents are of the opinion that the study does not sufficiently consider the price formation mechanisms. Furthermore, the study gives no information about resulting prices, which makes it more difficult to fully understand the results. The difficulty of market participants to understand how prices are determined could result in a barrier to their ability to enter the market.	ACER considers that the study mentions integer programming pricing as the pricing mechanism it adopts. See page 19 and 42 of the report. An analysis of the resulting prices, for both the day-ahead model and the real-time module, was not feasible within the timeline of the project. ACER considers that the unavoidable complexity of the market coupling algorithm, even in the current situation, does not allow the results of the day-ahead auction to be easily understood by interested stakeholders. At the same time, ACER does not believe that this should be an intrinsic goal of the process. Transparency of the results needs to be ensured with a sufficiently detailed public description of the functioning of the algorithm.
2 respondents express concern on the fact that the central dispatch approach misses the benefits of self-balancing and self-dispatching.	Central dispatch is a natural consequence of assuming a unit-based bidding model. However, the issue of fixed and variable costs is also relevant for portfolios. The current bidding language is a rough approximation of how to disaggregate fixed costs and variable costs of individual units; this is one of the caveats of the study which plays in favour of sequential clearing when assessing the benefits of co-optimisation. The model does account for

	portfolio coordination by running the extra step of a real-time run, where units have coordinated by adapting their setpoints assuming perfect information about all other resources in the system. This is clearly overly optimistic, so we expect this real-time step to overstate the potential coordination abilities of portfolio coordination, since Europe is clearly not a single transnational portfolio.
2 respondents acknowledge the value of investigating future developments of the market coupling algorithm but find it premature to hurry up with co-optimisation as it is only one of the options for efficient exchanges of balancing capacity.	ACER agrees. The development of the market-based allocation of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves needs to be continued in parallel to investigating the options for the implementation of co-optimisation.
2 respondents consider that modelling nuclear power plants as non-dispatchable is incorrect. This hypothesis might vastly overestimate the benefits of co-optimisation.	First, ACER notes that the benefits at the day-ahead stage are not affected. Assuming full dispatchability of nuclear power plants would only reduce the benefits in real-time, under very generous assumption on the possibility to correct dispatch out of the market. Second, the relevant literature shows that nuclear power plants have typically been considered as base load sources, while responses to load variations have been managed by other technologies. Despite the above, the contractor carried out a sensitivity analysis based on 50% dispatchability of nuclear power plants in France, which leads to welfare benefits of 1.25% compared to the status quo. With full dispatchability of nuclear power plants in France, the benefits reduce to 0.9%.
2 respondents state that the removing the 10% limit of using cross-zonal capacity for balancing could favour co-optimisation. 1 respondent states that it is not clear whether there are any limitations to the percentage of capacity that can be allocated to the exchange of balancing energy using co-optimization. 1 respondent regrets that no explicit limit for exchanging balancing capacity or sharing reserves is foreseen under Article 40 of the EB Regulation.	ACER clarifies that, pursuant to the EB Regulation, the 10% limit is only applicable to the market-based approach and not to co-optimisation. This requirement has been duly considered in the study. A sensitivity analysis lifting this constraint for the market-based process is described in Appendix G2 of the report.
2 respondents mention the importance to adequately consider Combined Heat and Power (CHP) units in the assessment. 1 respondent remarks that that the gate closure time for submission of bids to the market coupling	ACER invites the concerned market participants to actively contribute to the R&D activities led by NEMOs and TSOs such that the specificities of

algorithm should not be anticipated compared to today's situation since CHP producers must first know the outcome of the heat market before submitting bids to the market coupling algorithm.	this type of generation technology are duly considered in the analysis.
1 respondent deems that the sequential clearing modelled in the study does not consider market participants anticipations' about being or not selected in the day-ahead energy market. However, according to 1 respondent, it is unclear if the value to be considered for balancing capacity bids should also incorporate the probability of obtaining additional benefits in balancing energy activation. Moreover, start-up costs, ramping costs and potential loss for producing at minimum capacity in the day-ahead energy market seem to be considered in a very simplified way.	An underlying assumption in the study is that day-ahead market conditions should reflect expected real-time conditions, therefore intraday adjustments and the probability of activations in the balancing energy timeframe should not offer an additional expected revenue in a liquid market without arbitrage opportunities. Considering the above, ACER considers that the only fundamental cost driver for offering balancing capacity is given by the opportunity cost of not being cleared in the day-ahead energy market. Depending on the level of expressiveness of the bid design, the only cost component which might add to the opportunity cost could be given by some non-convex fixed costs which might or might not be covered by the balancing capacity price. Regarding the representation of fixed costs, ACER notes that how to account for them in sequential clearing designs is not trivial as both status quo and market-based lead to an intrinsic misrepresentation of them. Even after the publication of the Welfare Study, several variants for their representation have been assessed by the contractor, all of them resulting in a poorer performance of sequential clearing designs with respect to co-optimisation.
1 respondent asks for more details on what is expected from this study since the theoretical approach does not allow to assess every aspect of the implementation of the co-optimisation.	ACER considers that, while the study quantifies the benefits of co-optimisation under a given set of assumptions, the main objective of this study is to perform a proof-of-concept showing that co-optimisation does carry a significant potential to save costs at the EU level. In depth-investigations linked to the implementation of co-optimisation are to be carried out by NEMOs and TSOs according to the R&D plan set out in the present Decision.
1 respondent points out the specificities and potential difficulties of an application of co-optimisation in the Single Electricity Market (SEM) of Ireland and Northern Ireland and express their preference to use a market-based approach.	ACER observes that, at this point in time and to the best of its knowledge, there has not been any concrete interest to implement the market-based process in SEM. Regarding the specificities and potential difficulties of an application of co-optimisation, ACER invites the

	concerned respondent to play an active role in the upcoming R&D activities to address the expected risks and concerns.
1 respondent observes that the study does not assess the alternative sequencing of day-ahead energy and balancing capacity markets (i.e. 'inverted market-based'). Running the balancing capacity market after the day-ahead energy market will automatically mitigate the pertinent contributors to the welfare loss, which include fixed costs and opportunity costs. In addition, this alternative sequencing will not raise any additional concerns regarding the availability of the required balancing capacity.	ACER acknowledges that the study does not assess this alternative design option. This choice was dictated by constraints related to the execution of the project, the duration of which did not allow to examine any additional scenarios. Anyhow, ACER understands that the forecast of balancing capacity prices instead of day-ahead prices in such a sequence could be quite challenging, while without such forecast no inframarginal assets could be considered for balancing capacity, which can lead to inefficiencies. By default, coordination optimality between energy and balancing capacity market would always be more efficiently achieved with the co-optimised process compared to any sequential process.
1 respondent emphasises the need to investigate the impacts of co-optimisation on operational security.	ACER agrees that this aspect needs to be further assessed. It is covered under Article 4(15)(d) of the main document.
1 respondent questions whether the choice of eight day-types allows to capture time coupling and seasonality effects, which are particularly relevant for pumped hydro storage plants and renewables, respectively.	Pumped hydro is optimised endogenously within the model for each of the day types, so time coupling for such resources is accounted for within the eight day types. Within each day type, multiple scenarios of wind and solar are considered in the real-time balancing model, thus seasonality is accounted for in this respect. Longer-term time coupling effects related to hydro reservoirs are not accounted for, and these resources are rather fixed to historical values. In any case the eight day types adopted in the study have been employed in peer-reviewed journal publications in some of the most prestigious journals of the engineering and power system economics community, see (Aravena, 2017), (Aravena, 2021), and (Papavasiliou, 2013), where the latter has received the 2015 best publication award in energy from the Institute for Operations Research and the Management Sciences.
1 respondent considers that the study shows the value and thus importance of co-optimisation, which is already well established in economic	ACER agrees that co-optimisation is not a concept which is solely relevant in the European context. At the same time, significant differences exist between the mentioned jurisdictions and

literature and implemented in multiple jurisdictions, especially in the US.	the specificities of the European electricity markets.
1 respondent points out that co-optimisation goes well with other reforms that are expected to bring value, such as nodal pricing.	ACER points out that the study does not carry any implication about the potential benefits of other change of the European electricity market design, such as nodal pricing.

Annex I: List of respondents

No.	Organisation	Country
1.	BDEW	Germany
2.	Centrica	United Kingdom
3.	CEZ	Czechia
4.	CNMC	Spain
5.	CRE	France
6.	EDF	France
7.	EirGrid & SONI	Ireland
8.	EnBW	Germany
9.	Eneco	The Netherlands
10.	Energy Traders Europe	The Netherlands
11.	ENTSO-E	Belgium
12.	Eurelectric	Belgium
13.	Europex	Belgium
14.	Green Power Denmark	Denmark
15.	Illwerke	Austria
16.	Metlen	Greece
17.	NEMO Committee	
18.	Orsted	Denmark
19.	Österreichs E-Wirtschaft	Austria
20.	RAP	

21.	RWE	Germany
22.	Swedenergy	Sweden
23.	TIWAG	Austria
24.	TotalEnergies	France