NVE
Reguleringsmyndigheten for energi – RME

Vedlegg 2

Metode om priskoplingsalgoritmen og matchingsalgoritmen for kontinuerlig handel, inkludert et felles sett med kriterier etter CACM artikkel 37(5)

1. Requirements on functionalities and performance

1.1 General requirements.

a) For each bidding zone, the price coupling algorithm shall be able to:

(i) Facilitate orders for several Market Time Units ('MTU'), such as 15 minutes, 30 minutes and hourly.

(ii) Support the products and order types in accordance with the DA Products methodology pursuant to Article 40 of the CACM Regulation.

(iii) Support the SPBC of manual frequency restoration reserves ('mFRR') and automatic frequency restoration reserves ('aFRR') in both directions in accordance with the SPBC methodology pursuant to Article 25(2) of the EB Regulation.

(iv) Facilitate the consideration of any TSO balancing capacity ('BC') demand for a SPBC.

(v) Facilitate configurations with more than one NEMO for a given bidding zone or a scheduling area in accordance with the multiple NEMO arrangement as referred to in Article 45 of the CACM Regulation.

(vi) Support multiple scheduling areas within a bidding zone as requested by TSOs.

(vii) Allocate cross-zonal capacities on a bidding zone border with one or multiple TSOs on one or both sides of the concerned bidding zone border.

b) In accordance with 1.1(a)(iv), the price coupling algorithm shall consider applicable sharing agreement(s). This includes the consideration of:

(i) For control capability receiving TSOs, the possible reduction of procured volumes from the TSO BC demand through the sharing of reserves.

(ii) Selection of the applicable capability providing TSO(s).

State	Owner	
Requirement deadlines	TSOs	NEMOs
JAN 2021[2]	X	X
EXISTING		X
COOPT[3]	X	
COOPT	X	
EXISTING	X	X
EXISTING	X	
EXISTING	X	
COOPT	X	

[2] Hourly orders are already an existing functionality.
[3] All requirements denoted as 'COOPT' are not yet applicable and their specification and implementation is subject to further R&D.

If a load frequency control block consists of more than one bidding zone, the price coupling algorithm shall be able to address geographical limitations within such load frequency control block in accordance with Article 157(2)(g) of the SO Regulation in the same way as for sharing of reserves.			
c) The price coupling algorithm shall aim at maximising the sum of: (i) the economic surplus for SDAC; and	EXISTING	X	X
(ii) the economic surplus from the exchange of balancing capacity or sharing of reserves in accordance with the harmonised cross-zonal capacity allocation methodology pursuant to Article 38(3) of the EB Regulation, once approved in accordance with the relevant legal framework, as incorporated into the EEA Agreement,	COOPT	X	
for the concerned delivery day, consistent with time limitations, conditions and requirements established by NEMOs and TSOs.	EXISTING	X	X
d) The price coupling algorithm shall provide for a fair and orderly price formation in accordance with Article 3(h) of the CACM Regulation.	EXISTING		X
e) The price coupling algorithm shall support multiple bidding zones within a country and shall be scalable to cover all bidding zones eligible for participating in SDAC.	EXISTING	X	X
f) The price coupling algorithm shall allow to configure which bidding zones and bidding zone borders are considered for co-optimisation for which SPBC per direction. Besides the bidding zone borders directly involved in an application in accordance with Article 38(1)(a) of the EB Regulation, the price coupling algorithm shall consider bidding zone borders which are impacted by the relevant application. In case of an application with bidding zone border from a capacity calculation region ('CCR') applying the flow-based approach, at least all bidding zone borders within the CCR shall be considered by the price coupling algorithm for the relevant application in accordance with Article 38(1)(a) of the EB Regulation.	COOPT	X	
g) The price coupling algorithm shall be able to perform co-optimisation for all SPBCs for the relevant bidding zones and bidding zone borders in accordance with all applications pursuant to Article 38(1)(a) of the EB Regulation as selected pursuant to (e).	COOPT	X	

h) In case the price coupling algorithm finds solutions with equal social welfare, it shall apply deterministic rules in order to define prices and net positions for each bidding zone.	EXISTING	X	X
i) In case of solutions with equal sum of social welfare for a certain SPBC in a positive or negative direction and day-ahead energy, the price coupling algorithm shall allocate the marginal volume of cross-zonal capacity to day-ahead energy.	COOPT	X	
j) In case of equal results in the same social welfare optimisation outcome, the price coupling algorithm shall allocate the marginal volume of cross-zonal capacity by default to the SPBC type following the order of aFRR > mFRR and for the same type, direction positive > direction negative. The price coupling algorithm shall allow to configure a different prioritisation rule per bidding zone border on request of the respective TSO(s).	COOPT	X	
k) The price coupling algorithm shall be reliable, thus able to find a solution within the allowed time limit, including the potential to extend the calculation time in case the allowed calculation time is exceeded.	EXISTING	X	X
l) The price coupling algorithm shall be able for each MTU to provide the net position per NEMO trading hub and the input for the calculation of the scheduled exchanges between bidding zones or scheduling areas.	EXISTING	X	X
m) The price coupling algorithm shall be able to calculate the scheduled exchanges between bidding zones or scheduling areas.	EXISTING	X	
n) The integrity of the price coupling algorithm and the data it processes shall be properly secured from unauthorised access.	EXISTING	X	X
1.2 Qualitative requirements with precision and price ranges			
a) The price coupling algorithm shall: (i) Ensure equal treatment of orders coming from all NEMOs and TSOs in accordance with Article 3(e) of the CACM Regulation. (ii) Provide all orders non-discriminatory access to cross-zonal capacity in accordance with Article 3(j) of the CACM Regulation.	EXISTING	X	X
b) In case of tie rules (between two or more orders) and for branching decisions (if any), deterministic rules shall be implemented. Such choices shall be logged.	EXISTING	X	X

c) The price coupling algorithm shall allow for partial decoupling.	EXISTING	X	X
d) The price coupling algorithm shall automatically support leap years, i.e. 366 days in a year.	EXISTING	X	X
e) The price coupling algorithm shall support 23, 24 or 25 hours for a trading day.	EXISTING	X	X
f) The calculation process of the price coupling algorithm, including prices and scheduled exchanges resulting from this calculation process, shall be transparent, auditable, and explainable. This requirement applies also to all deterministic rules and applied algorithm heuristics and occurrence rate of these rules and heuristics.	EXISTING	X	X
g) The price coupling algorithm source code shall be well structured and well documented.	EXISTING		X
h) The price coupling algorithm shall support negative day-ahead energy prices for each bidding zone.	EXISTING		X
i) The price coupling algorithm shall be able to round calculated prices and volumes according to bidding zone specific ticks and rounding rules.	EXISTING	X	X
j) The maximum price for day-ahead energy and any SPBC subject to an application in accordance with Article 38(1)(a) of the EB Regulation shall be the maximum price for SDAC in accordance with the methodology pursuant to Article 41(1) of the CACM Regulation.	COOPT	X	
1.3 Performance			
a) The price coupling algorithm shall be robust and reliable, and it shall be resilient to pretested data configurations such as, but not limited to, non-crossing of bids and offer curves, orders' curtailment, maximum and minimum prices, price and volume indeterminacy.	EXISTING	X	X
b) The price coupling algorithm shall always produce a unique result, i.e. price and volume indeterminacy shall be resolved.	EXISTING	X	X
c) The price coupling algorithm shall use reliable IT technology, e.g. reliable third-party software.	EXISTING	X	X
d) The price coupling algorithm shall be available at all times when required.	EXISTING	X	X
e) The price coupling algorithm shall be adequately scalable when the number of bidding zones increases. The price coupling algorithm shall cope with new markets that need to be incorporated in the price coupling, either corresponding to geographical	EXISTING	X	X

EXISTING	X	X
COOPT	X	

extensions, or with additional NEMOs in existing bidding zones.

f) Price taking day-ahead energy orders are buy (respectively sell) limit orders submitted at the maximum (respectively minimum) prices. The failure to accept these prices taking day-ahead energy orders corresponds to a curtailment situation:

(i) in case of over-supply, not all price taking day-ahead energy supply orders can be accepted;

(ii) in case of under-supply, not all price taking day-ahead energy demand orders can be accepted.

Day-ahead energy curtailment can be partially mitigated by exporting excess energy or importing deficit energy. In case more than one bidding zone faces a day-ahead energy curtailment situation, when the curtailment of one increase, the curtailment of the other will decrease. Per bidding zone, it should be possible to either:

(i) prevent sharing of curtailment: the local curtailments remain local; no support is received or provided to the adjacent bidding zone; or

(ii) share curtailment: the difference in relative (percentage) curtailment between the different bidding zones is minimised.

The option of sharing curtailment in point (ii) above also applies in case of an application of flow-based approach, where sharing curtailments may be at the cost of the economic surplus.

The price coupling algorithm shall provide a mechanism that allows for a sharing of day-ahead energy curtailment between bidding zones in a flow-based capacity allocation.

g) In case there is not sufficient available SPBC sell orders by balancing service providers ('BSPs') to satisfy locally the TSO's demand for the SPBC, the TSO surplus shall be calculated based on a virtual clearing price equal to the maximum possible clearing price of the SPBC.

2. Requirements related to cross-zonal capacities

2.1 The price coupling algorithm shall be able for each MTU to:

EXISTING	X	

a) Allow setting cross-zonal capacity value for each bidding zone border in accordance with the CACM Regulation in case coordinated net transfer capacity is applied.

b) Constrain scheduled exchanges to the respective cross-zonal capacity value for each bidding zone border for each direction, in case the coordinated net transfer capacity approach is applied.	EXISTING	X	
c) Where applicable, allow TSOs setting a default value for cross-zonal capacity for each bidding zone border and for each direction in case coordinated net transfer capacity approach is applied.	EXISTING	X	
d) Constrain, where appropriate, an aggregated set of cross-zonal interconnectors with one global cross-zonal transmission capacity limit (cumulative ATC), i.e. a general boundary constraint. This constraint shall be applicable also to a predefined set of bidding zone borders in order to limit, for example, the net position of a bidding zone(s).	EXISTING	X	
e) Allow to define a positive and a negative limit to the net position for each bidding zone.	AUG 2022	X	
f) Process flow-based parameters, if provided at the defined MTU, when allocating cross-zonal capacities for each bidding zone border.	EXISTING	X	
g) Allow definition and application of the following flow-based parameters for each network element of a given bidding zone for the flow-based approach:			
(i) power transfer distribution factor ('PTDF') as defined in the Transparency Regulation; and	EXISTING	X	
(ii) available margin on critical network element as referred to in the Transparency Regulation.	EXISTING	X	
h) Where the flow-based approach is applied, the price coupling algorithm shall ensure that the available margins for each critical network element are not exceeded when:	EXISTING	X	
(i) the PTDF matrix is multiplied by the net position; and			
(ii) considering the PTDF values for all possible positions from balancing energy flows following from the exchange of balancing capacity or sharing of reserves for each considered SPBC and per direction.	COOPT	X	
i) Receive the flow-based parameters as:			
(i) 'zero balanced' meaning that the available margin on critical network elements applies from zero exchanges and that pre-existing exchanges are transmitted aside; or	AUG 2022	X	

(ii) 'not zero balanced' meaning that the available margin on critical network elements applies from pre-existing exchanges.	EXISTING	X	
j) Allow the coexistence of both flow-based and coordinated net transfer capacity approaches within the coupled regions, i.e. hybrid coupling.	EXISTING	X	
k) Allow the use of virtual bidding zones to model how the critical network elements of a CCR applying the flow-based approach are impacted by cross-zonal exchanges on high voltage direct current ('HVDC') interconnectors within a CCR or by cross-zonal exchanges on bidding zone borders outside the CCR that are applying the coordinated net transfer capacity approach.	EXISTING	X	
l) The price coupling algorithm shall allow TSOs to set a limit for the maximum volume of allocated cross-zonal capacity for the exchange of balancing capacity or sharing of reserves in accordance with the harmonised cross-zonal capacity allocation methodology pursuant to Article 38(3) of the EB Regulation, once approved in accordance with the relevant legal framework, as incorporated into the EEA Agreement.	COOPT	X	
m) In case two TSOs exchange balancing capacity and perform sharing of reserves with the same SPBC in the same direction, the price coupling algorithm shall allocate cross-zonal capacity corresponding to the difference between the TSO BC demand without sharing of reserves and the actually procured TSO BC demand of the TSO that is importing sharing of reserves.	COOPT	X	
n) The price coupling algorithm shall allow that the same cross-zonal capacity is allocated to both directions of a SPBC of a certain quality (i.e., a common allocation for both directions of each SPBC) for the exchange of balancing capacity or sharing of reserves in accordance with the harmonised cross-zonal capacity allocation methodology pursuant to Article 38(3) of the EB Regulation, once approved in accordance with the relevant legal framework, as incorporated into the EEA Agreement.	COOPT	X	

3. Requirements related to allocation constraints

3.1 The price coupling algorithm shall be able to:

a) Constrain the increase/decrease of scheduled exchanges over one direct current ('DC') interconnector and/or a combination of DC interconnectors from a MTU to the following MTU or	EXISTING	X	

between the last MTU from the day before and the first MTU of the following day.			
b) Constrain the increase/decrease of scheduled exchanges over one DC interconnector and/or a combination of DC interconnectors from a MTU to the following MTU or between the last MTU from the day before and the first MTU of the following day taking into account the nominations of long-term capacity allocations, i.e. physical transmission rights, where applicable. The constraint shall be handled on a single DC interconnector and multiple DC interconnectors in combination.	AUG 2022	X	
c) Constrain the increase/decrease of net positions of a single bidding zone from a MTU to the following MTU within a day or between the last MTU from the day before and the first MTU of the following day.	EXISTING	X	
d) Incorporate day-ahead energy losses functionality on interconnector(s) between bidding zones during capacity allocation, and activate this functionality during allocation, if requested by the owner(s) of the relevant interconnector after the approval by the relevant regulatory authorities.	EXISTING	X	
3.2 The price coupling algorithm shall allow to set a minimum day-ahead energy price difference between adjacent bidding zones when a DC interconnector is used for electricity exchange. For this requirement, the price coupling algorithm shall model the costs incurred for each MWh passing through a DC interconnector as a 'flow tariff'. The 'flow tariff' shall be treated as a threshold for the price between the bidding zones connected by the DC interconnector. If the price difference between the relevant bidding zones is less than the 'flow tariff', the scheduled exchange shall be set to zero. If there is a scheduled exchange, the price difference shall equal the 'flow tariff', unless there is a congestion. Once the price difference exceeds the 'flow tariff', the congestion income becomes positive. This functionality shall be incorporated in the price coupling algorithm and activated during allocation if requested by the owner(s) of the interconnector after approval by the relevant regulatory authorities.	EXISTING	X	
3.3 The price coupling algorithm shall allow for exchanges from higher price bidding zone to lower price bidding zone, if this leads to an increase in overall economic surplus.	EXISTING	X	
3.4 The price coupling algorithm shall consider constraints for the exchange of balancing capacity or sharing of reserves in accordance with the maximum procurement volume of balancing capacity per direction for a specific bidding	COOPT	X	

zone, or a set of bidding zones, due to operational security requirements pursuant to Article 165(3)(g) of the SO Regulation.			
3.5 The price coupling algorithm shall consider constraints for the exchange of balancing capacity or sharing of reserves in accordance with the minimum procurement volume of balancing capacity per direction for a specific bidding zone, or a set of bidding zones, defined in accordance with the dimensioning process pursuant to Article 157(2)(g) of the SO Regulation.	COOPT	X	
3.6 The price coupling algorithm shall be able to calculate the possible cross-border balancing energy flows from the exchange of balancing capacity or sharing of reserves between all relevant bidding zones or scheduling areas. The price coupling algorithm shall respect the allocation constraints in accordance with 3.1(a), (b), and (c) by considering all of these possible cross-border balancing energy flows from the exchange of balancing capacity or sharing of reserves.	COOPT	X	
4. Requirements related to balance constraints			
4.1 For overall balance of all bidding zones, the price coupling algorithm shall ensure that the sum of unrounded net positions and transmission losses, where applicable, of all bidding zones shall be zero.	EXISTING	X	
4.2 For overall balance of a bidding zone, the price coupling algorithm shall ensure for each bidding zone the sum of unrounded net position and transmission losses, where applicable, shall be equal to the sum of import and export of this bidding zone resulting from the day ahead capacity allocation.	EXISTING	X	
5. Requirements on algorithm output and deadlines for the delivery of SDAC results			
5.1 Regarding the prices for each MTU, the output of the price coupling algorithm shall be:			
a) Rounded and unrounded marginal price in Euros for day-ahead energy in each bidding zone.	EXISTING	X	X
b) Shadow prices of critical network elements for day-ahead energy as needed for flow-based capacity allocation.	EXISTING	X	
c) Regional reference prices for day-ahead energy, in a network in which the cross-zonal capacity constraints are relaxed, e.g. the Nordic region.	EXISTING	X	X
d) Rounded and unrounded marginal price in Euros for each bidding zone and SPBC per direction subject to an application in accordance with Article 38(1)(a) of the EB Regulation.	COOPT	X	

e) Shadow prices of critical network elements as needed for flow-based capacity allocation for each SPBC per direction subject to an application in accordance with Article 38(1)(a) of the EB Regulation.	COOPT	X	
5.2 Regarding the quantities for each relevant MTU, the output of the price coupling algorithm shall be:			
a) Rounded and unrounded net position for each bidding zone, which is defined as the difference between accepted supply and demand day-ahead energy orders within a bidding zone, where rounding shall follow the rounding rules defined for each bidding zone.	EXISTING	X	X
b) Where there are multiple NEMOs within a bidding zone and scheduling area, the rounded and unrounded net position for each NEMO trading hub in a bidding zone.	EXISTING	X	X
c) The information which enables the execution status of orders to be determined.	EXISTING		X
d) The number and volume of accepted block orders for each bidding zone and paradoxically rejected orders, if any.	EXISTING		X
e) Scheduled exchanges into and out of individual relevant DC network elements (difference in scheduled exchanges in/out reflecting losses where applicable).	EXISTING	X	
f) Scheduled exchanges on relevant bidding zone borders (scheduled exchanges in/out reflecting losses where applicable).	EXISTING	X	
g) Scheduled exchanges on relevant scheduling area borders (scheduled exchanges in/out reflecting losses where applicable).	EXISTING	X	
h) Volume of accepted TSO BC demand of each SPBC per direction.	COOPT	X	
i) In case of unsatisfied TSO BC demand, the volume of unsatisfied demand per SPBC per direction.	COOPT	X	
j) The amount and direction of shared SPBC volumes for each TSO BC demand per SPBC per direction, when sharing of reserves is applied as addressed under 1.1(b).	COOPT	X	
k) Volume of accepted SPBC supply orders per each SPBC per direction and per bidding zone.	COOPT	X	
l) Volume of procured TSO BC demand of each SPBC per direction, which relied on allocation in accordance with 2.1(m) and (n).	COOPT	X	
5.3 For each MTU, the price coupling algorithm shall provide:			
a) Where the coordinated net transfer capacity approach is applied: the allocated quantity for the exchange of	EXISTING	X	

day-ahead energy per bidding zone border (as a portion of the available transmission capacity value). b) Where the flow-based approach is applied: the allocated quantity for the exchange of day-ahead energy per critical network element with contingency (as a portion of the available margin).			
5.4 For each MTU and SPBC per direction subject to an application in accordance with Article 38(1)(a) of the EB Regulation, the price coupling algorithm shall provide: a) Where the coordinated net transfer capacity approach is applied: the allocated quantity for the exchange of balancing capacity or sharing of reserves per bidding zone border (as a portion of the available transmission capacity value). b) Where the flow-based approach is applied: the allocated quantity for the exchange of balancing capacity or sharing of reserves per critical network element with contingency (as a portion of the available margin).	COOPT	X	
5.5 For each relevant MTU, the price coupling algorithm shall provide scheduled exchanges resulting from day ahead market coupling in the form of:			
a) bilateral and multilateral scheduled exchanges between scheduling areas;	EXISTING	X	
b) bilateral and multilateral scheduled exchanges between bidding zones; and	EXISTING	X	
c) bilateral and multilateral scheduled exchanges between NEMO trading hubs,	EXISTING	X	X
and pursuant to the methodology for calculating scheduled exchanges. This is to support the scheduled exchanges calculation and/or multi-NEMO arrangements function.			
5.6 Regarding the calculation results, the output of the price coupling algorithm shall be:			
a) the overall economic surplus for day-ahead energy and economic surplus for day-ahead energy for each bidding zone and delivery day;	EXISTING	X	X
b) the output necessary for monitoring in accordance with Articles 82(2) and (4) of the CACM Regulation; and	EXISTING	X	X
c) the overall economic surplus from the exchange of balancing capacity or sharing of reserves and economic surplus from the exchange of balancing capacity or sharing of reserves for each bidding zone and SPBC.	COOPT	X	

5.7 The price coupling algorithm shall provide NEMOs and TSOs with information necessary to comply with the monitoring pursuant to Regulation (EU) 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency ('REMIT Regulation'), subject to the incorporation of this regulation into the EEA Agreement, where such information can be obtained only from the price coupling algorithm.	EXISTING	X	X
5.8 The price coupling algorithm shall be able to implement a change of bidding zone configurations following the change control procedure referred to in Article 9 of the Algorithm methodology.	EXISTING	X	
5.9 The price coupling algorithm shall be capable of finding results normally within the time limit that is established in the operational procedure referred to in Article 4(18) of the Algorithm methodology.	EXISTING	X	X
5.10 The price coupling algorithm shall be able to deliver the volume of matched day-ahead energy orders and not-matched day-ahead energy orders of each NEMO for bidding zones or scheduling areas if requested by the relevant TSOs.	EXISTING	X	

6. Currency

6.1 The price coupling algorithm shall only accept matching in Euro, i.e. all input and output currency data shall be in Euros. This should not prevent local currency orders and settlements.	EXISTING	X	X

7. Requirements on the cross-product linking in a co-optimised allocation process

7.1 The price coupling algorithm shall allow intertemporal and cross-product dependencies of orders for day-ahead energy and SPBC (and vice versa).	COOPT	X	
7.2 In case the price coupling algorithm finds solutions with equal social welfare with the selection of an order linked across a SPBC and day-ahead energy, the price coupling algorithm shall prioritise the activation of the order for day-ahead energy.	COOPT	X	
7.3 In case of a TSO BC demand for several SPBCs, the price coupling algorithm shall shift the TSO BC demand only from lower quality type of SPBC to higher quality type of SPBC if the relevant TSO agreed before to apply substitution of reserves and if it causes cost minimisation in accordance with Articles 58(3)(a) and 32(1) of the EB Regulation. The quality order is set as follows: aFRR > mFRR.	COOPT	X	

7.4 In case the price coupling algorithm finds solutions with equal social welfare with the selection of an order linked across different SPBCs, the price coupling algorithm shall prioritise in the order of aFRR > mFRR. The price coupling algorithm shall allow to configure a different prioritisation rule on request of the respective TSO(s).	COOPT	X
7.5 In case there is not sufficient available SPBC sell orders by BSPs to satisfy a TSO BC demand for more than one SPBC in the same direction, the price coupling algorithm shall prioritise the selection of cross-product linked SPBCs orders, by default, in the following order aFRR > mFRR. The price coupling algorithm shall allow to configure a different prioritisation rule on request of the respective TSO(s).	COOPT	X