Annex 3 to the Algorithm methodology:

Algorithm monitoring methodology for single dayahead coupling

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TITLE 1

General provisions

Article 1
General specifications

1. This Annex elaborates the principles for the required indicators monitoring the SDAC algorithm. More specifically, it is referred to by the following Articles in the Algorithm methodology:
   a) Article 7: Calculation of effective usage, anticipated usage and usage range, using the defined data sets and the scalability indicator for calculating the usage range;
   b) Article 8: Monitoring algorithm performance;
   c) Article 9: Scalability report;
   d) Article 11: Research and development activities;
   e) Article 12: Corrective measures; and
   f) Article 18: Impact assessment methodology for SDAC and IDA algorithms, for the assessment of requests for change.

2. The principles and processes described in this methodology shall be further developed and detailed within the algorithm monitoring procedures in the DA framework.
3. Unless specified otherwise, all the values that are defined as parameters in this methodology shall be defined in the operational procedures of the relevant operational agreements and their value will be shared in the public reports.
4. In order to assure the continuation of in-place legal duties and support, the implementation of the co-optimisation, the titles of this Annex are split into SDAC and co-optimisation titles:
   a. Titles 2, 3, 4 and 5 cover SDAC topics;
   b. Titles 7, 8 and 9 cover co-optimisation topics.

Article 2
Data sets for indicators

Being 'M' the month and 'Y' the year in which assessment is done, the indicators shall be calculated with a daily granularity over different temporal sets of delivery days. Specifically:

a) the recent historical set shall comprise the delivery days of the previous K (K<13) months, starting from the Kth month ('M') before the assessment (M-K) up to the previous month (M-1) and may exclude for practical reasons the days on which a Daylight-Saving Time change occurs and/or any days on which a partial/total decoupling occurs. The K value shall be defined in the operational procedures;
b) the rolling historical set shall comprise the previous year's delivery days, starting from the 13th month before the assessment (M-13) up to the previous month (M-1) and may exclude for practical reasons the days on which a Daylight-Saving Time change occurs and/or any days on which a partial/total decoupling occurs;
c) the whole year historical set will comprise the previous full years' delivery days (Y-1), counting only complete years, and may exclude for practical reasons the days on which a Daylight-Saving Time change occurs and/or any day on which a partial/total decoupling occurs;

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d) the near future set for the indicator calculation shall be defined by reference to the projected growth of the whole year historical set for the following year (Y+1) and taking into account all the forward-looking system information expected at the time of evaluation; and
e) the distant future set for the indicator calculation shall be defined by reference to the projected growth for of the whole year historical set for the following three years (Y+3) and taking into account all the forward-looking system information expected at the time of evaluation.

TITLE 2

Application of Indicators for the SDAC algorithm

Article 3
Monitoring of operations and reporting

1. For monitoring and reporting the evolution of the SDAC algorithm the performance indicators described under Title 3, 4 and 5 shall be used.
2. The usage indicators under Title 4 shall be monitored by comparing the effective usage of their functionality in the recent historical set pursuant to Article 2(a) for all days against the usage range of the same functionality, which was calculated pursuant to Article 5(3).
3. The economic surplus indicator pursuant to Article 7 and the repeatability indicator pursuant to Article 8 shall be monitored by assessing the values of the recent historical set pursuant to **Error! Reference source not found.**2(a), against the values of the rolling historical set pursuant to **Error! Reference source not found.**2(b).
4. For monitoring the scalability, the values of the recent historical set pursuant to Article 2(a) shall be assessed against the thresholds of the scalability indicator pursuant to Article 9(2).
5. For reporting purposes, the indicators referred to under Title 3, 4 and 5 shall use the rolling historical set pursuant to Article 2(b).
6. For reporting purposes an average of values may be applied.

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Article 4
Request for Change impact assessment

1. The request for change impact assessment should assess the impact on scalability by a request for change.
2. The assessment of the scalability indicator shall be performed for:
   a) the historical scenario: using as inputs the actual usage of all the existing functionalities as recorded over the whole year historical set under Article 2(c) and the anticipated usage of the functionality under assessment calculated over the near future set under Article 2(d) and applying the relevant thresholds in accordance with Article 9(2);
   b) the near future scenario: using as inputs the anticipated usage of all the functionalities calculated on the near future set under Article 2(d) and using the relevant thresholds in accordance with Article 9(2).

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Article 5
Scalability assessment

1. The scalability assessment should assess the impact of the long-term anticipated growth on the SDAC algorithm scalability, considering the expected increase of usage of functionalities.
2. The relevant thresholds pursuant to Article 9(2) shall be applied on the values resulting from simulation of the SDAC algorithm including the anticipated usage of all functionalities on:

   a) the near future set pursuant to Article 2(d) and
   b) the distant future set pursuant to Article 2(e).

3. The usage range shall be calculated as the maximum usage of the functionalities supported by the SDAC algorithm resulting from paragraph 2(b).

Article 6
Research and Development assessment

1. The research and development assessment should ensure the capability of the SDAC algorithm to support in the medium and long term the anticipated market growth and the extension of requirements and shall use all performance indicators defined under Title 3.
2. The performance indicators shall be calculated with the usage range of all the functionalities when simulating the run of the SDAC algorithm on the distant future set pursuant to Article 2(e) and shall be assessed as follows:

   a) for the scalability indicator the relevant thresholds in accordance with Article 9(2) shall be used;
   b) for the economic surplus indicator pursuant to Article 7 and the repeatability indicator pursuant to Article 8 the obtained values shall be assessed against the rolling historical set pursuant to Article 2(b).

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TITLE 3

Indicators on SDAC algorithm performance

Article 7
Indicators on SDAC algorithm's ability to maximize economic surplus

The indicators to monitor the ability of the SDAC algorithm to maximize the economic surplus are:

1. **Economic surplus gain with respect to the first solution** – This indicator is the difference between the economic surplus of the accepted solution and the economic surplus of the first solution found. This indicator is not valid for comparing two different versions of the SDAC algorithm. It should be used only as an indicative of the improvements of the solutions after first one is found.
2. **Economic surplus gain after increasing the calculation time by T minutes** – This indicator measures the gain in the economic surplus if the same delivery day is run again on a hardware with the same min requirements as the one used for delivering results, giving the SDAC algorithm T minutes more. This indicator needs to be calculated ex post SDAC algorithm calculation, in a different process.

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Article 8
Indicators on SDAC algorithm repeatability

The indicators to monitor algorithm repeatability reflect the differences of clearing prices and accepted quantities for different orders over the relevant MTUs and bidding zones between two runs of the SDAC algorithm. Potential differences shall be calculated while using the same inputs, configuration of hardware and software and at the same number of iterations and comparing the last common solutions in both runs.

Article 9
Indicators on SDAC Algorithm scalability

1. The indicator to monitor the algorithm scalability is the **Time to first solution**. This indicator measures the time spent since the algorithm starts until the first solution is found. It considers the time required for reading input data from database, the creation of the model for the optimisation problems and the resolution until the first solution has been found.
2. The scalability indicator pursuant to paragraph 1 shall be based on data sets in accordance with Article 2 and be assessed against the following thresholds (the 'x' and 'y' values shall be set in the algorithm monitoring procedure):

    a) in x% of the cases the indicator shall be lower than y minutes, and
    b) its average value shall be smaller than z minutes;

TITLE 4

Indicators on the SDAC algorithm usage

Article 10
Indicators to describe the usage of SDAC products

Indicators on the evolution of the number of submitted orders of each product type per bidding zone over time, and the corresponding total volume:

a) **Total number of steps at bidding zone level** – This indicator counts the total number of steps in the aggregated price-per-volume-curves for each bidding zone and MTU from all orders of all NEMO Trading Hubs. A step is a segment made of two consecutive curve points of the price-per-volume-curve with different quantities. One single value is provided per delivery day.
b) **Total number of block orders** – This indicator counts the total number of block orders per delivery day and bidding zone.
c) **Total number of block order exclusive groups** – This indicator counts the total number of exclusive groups existing for the block orders per delivery day.
d) **Total number of linked families** – This indicator counts the total number of families of linked block orders per delivery day.
e) **Total number of complex orders** – This indicator counts the total number of complex orders per delivery day and bidding zone.
f) **Total number of scalable complex orders** – This indicator counts the total number of scalable complex orders per delivery day and bidding zone.

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g) **Total number of demand merit orders** – This indicator counts the total number of demand merit orders per delivery day and bidding zone. These merit orders are not the PUN orders.
h) **Total number of supply merit orders** – This indicator counts the total number of supply merit orders per delivery day and bidding zone.
i) **Total number of PUN orders** – This indicator counts the total number of PUN orders per delivery day and bidding zone. That means the number of unique PUN prices regarding the input data.

Article 11
Indicators to describe the geographical extension of the SDAC

Indicators on the evolution of the number of bidding zones:

a) **Number of bidding zones** – Total number of bidding zones. This indicator is obtained by counting all the bidding zones existing per delivery day.
b) **Total number of flow-based bidding zones** – This indicator counts the total number of bidding zones in which there is flow based topology. This indicator is calculated by counting the number of PTDF matrixes that exist per delivery day.
c) **Number of scheduling areas** – Total number of scheduling areas. This indicator is obtained by counting all the scheduling areas existing per delivery day.
d) **Number of NEMO Trading Hubs** – Total number of NEMO Trading Hubs per delivery day.
e) **Number of NEMOs** – Total number of different NEMOs in the delivery day. One NEMO may be operating several NEMO Trading Hubs, each one in a different bidding zone and scheduling area.

Article 12
Indicators to describe the network constraints

Indicators on the evolution of the use of network constraints are:

a) **Total number of bidding zone lines** – This indicator counts the total number of lines between bidding zones.
b) **Total number of flow-based PTDF constraints** – This indicator counts the total number of PTDF constraints existing for all the flow-based bidding zones per delivery day. It is the same as the number of rows in the PTDF matrixes.
c) **Total number of scheduling area lines** – This indicator counts the total number of lines between scheduling areas.
d) **Total number of NEMO Trading Hub lines** – This indicator counts the total number of lines between NEMO Trading Hubs.

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TITLE 5

Indicators on the SDAC algorithm output

Article 13
Indicators to describe the output of maximization of economic surplus

Indicators on the maximization of economic surplus:

a) **Economic surplus of the first solution found -** is the market surplus, calculated Due to SDAC algorithm works floating-point format numbers, the precision of the calculations is limited. Quality of the solution is the quality in term of tolerances, using as value the worst level of tolerance achieved among all the checks applied to the constraints.

b) **Economic surplus of the final solution** - This indicator is obtained as provided by the SDAC algorithm, querying the utility of the solution that the SDAC algorithm classifies as the accepted solution per delivery day.

Article 14
Indicators to describe the status of orders

1. Indicators on the evolution of number of matched orders and paradoxically rejected orders of each product type over time, and the corresponding total volume;

a) **Total number of matched blocks** – This indicator counts the total number of matched blocks per delivery day and bidding zone.

b) **Total number of matched complex orders** – This indicator counts the total number of matched complex orders per delivery day and bidding zone.

c) **Total number of matched scalable complex orders** – This indicator counts the total number of matched scalable complex orders per delivery day and bidding zone.

d) **Total number of matched non-PUN merit orders** – This indicator counts the total number of matched merit orders (non-PUN merit orders) per delivery day and bidding zone. It will be calculated as the count of non-PUN merit orders whose matching quantity is greater than 0.

e) **Total number of matched PUN orders** – This indicator counts the total number of matched PUN orders per delivery day and bidding zone. That means the number of unique PUN prices regarding the input data. It will be calculated as the count of PUN orders whose matching quantity is greater than 0.

f) **Total matched volume from curves** – This indicator aggregates the total matched volume from supply and demand curves. It will be calculated as the sum of all "market time unit"-weighted unrounded volume matched at each relevant MTU and bidding zones for supply and demand curves.

g) **Total matched volume from blocks** – This indicator aggregates the total matched volume from blocks. It will be calculated as sum of all "market time unit"-weighted unrounded volume matched at each relevant MTU and bidding zones from blocks.

h) **Total matched volume from complex orders** – This indicator aggregated the total matched volume from complex orders. It will be calculated as sum of all unrounded volume matched at each relevant MTU and bidding zones from complex orders.

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i) **Total matched volume from scalable complex orders** – This indicator aggregated the total matched volume from scalable complex orders. It will be calculated as sum of all unrounded volume matched at each relevant MTU and bidding zones from scalable complex orders.

j) **Total matched volume from (non-PUN) merit orders** – This indicator aggregates the total matched volume from (non-PUN) merit orders. It will be calculated as sum of all unrounded volume matched at each relevant MTU and bidding zones from (non-PUN) merit orders.

k) **Total matched volume from PUN orders** – This indicator aggregated the total matched volume from PUN orders. It will be calculated as sum of all unrounded volume matched at each relevant MTU and bidding zones from PUN orders

2. Indicators on paradoxically rejected orders

a) **Number of PRBs in the final solution** – This indicator counts the total number of Paradoxically Rejected Blocks (PRBs) in the accepted solution per delivery day and bidding zone.

b) **Number of PRMICs in the final solution** – This indicator counts the total number of Paradoxically Rejected MICs (PRMICs) of the complex orders and scalable complex orders in the accepted solution per delivery day and bidding zone.

c) **Maximum Delta P in the final solution** – This indicator reports the maximum Delta P of the blocks for the accepted solution per delivery day.

d) **Maximum Delta MIC in the final solution** – This indicator reports the maximum Delta MIC of the complex orders and scalable complex orders for the accepted solution per delivery day.

e) **PRB utility loss in the final solution** – This indicator reports the utility (economic surplus) loss due to paradoxically rejected blocks per delivery day.

f) **PRMIC utility loss in the final solution** – This indicator reports the utility (economic surplus) loss due to paradoxically rejected MICs and MPCs of the complex orders and scalable complex orders per delivery day.

g) **Volume of PRBs in the final solution** – This indicator sums the volume of all the Paradoxically Rejected Blocks (PRBs) in the accepted solution per delivery day and bidding zone.

h) **Volume of PRMICs in the final solution** – This indicator sums the volume of all the Paradoxically Rejected MICs (PRMICs) of the complex orders and scalable complex orders in the accepted solution per delivery day and bidding zone.

3. Indicators on the evolution of the use of network constraints along the time;

a) **Number of periods for ATC/DC lines with flows at full capacity** – Total number of periods for which ATC/DC lines are utilized at full capacity in one of their directions. We consider a line fully utilized when the energy flow is equal to capacity.

Article 15
Indicators to describe the IT calculation process

Indicators on the time spent in every phase of the algorithm calculation process are:

a) **Input data reading time** – This indicator measures the time the SDAC algorithm requires in order to read all the data needed for a delivery day from the SQL database. Different methods exist for the calculation of this indicator:

b) **Input data delivery day creation** – This indicator measures the amount of time the SDAC algorithm requires in order to create a delivery day from the data read from the database.

c) **Time to solve the root node for the master computer** – This indicator measures the amount of time to solve the root node for the master tree.

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d) **Time to solve the root node for the job that found first solution** – This indicator measures the amount of time to solve the first node of the job that lead to the first OK solution found. This time will not include the time to read the input data and create the solver models. It will neither include the time spent in the master computers root node.

e) **Number of successive improvements of the solution in the given timeframe** – This indicator measures the number of OK solutions that improve a previously found solution during the optimisation process limited by the amount of time available for running the SDAC algorithm.

f) **Total number of nodes in the master branch and bound tree** – This indicator measures the number of nodes processed in the master branch and bound tree.

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TITLE 6

Application of Indicators to the Co-optimisation algorithm

Article 16
Monitoring of operations and reporting

1. For monitoring and reporting the evolution of the Co-optimisation algorithm the performance indicators described under Title 7, 8 and 9 shall be used.
2. The usage indicators under Title 8 shall be monitored by comparing the effective usage of their functionality in the recent historical set pursuant to Article 2(a) for all days against the usage range of the same functionality, which was calculated pursuant to Article 18(3).
3. The economic surplus indicator pursuant to Article 20 and the repeatability indicator pursuant to Article 21 shall be monitored by assessing the values of the recent historical set pursuant to **Error! Reference source not found.**2(a) against the values of the rolling historical set pursuant to **Error! Reference source not found.**2(b).
4. For monitoring the scalability, the values of the recent historical set pursuant to Article 2(a) shall be assessed against the thresholds of the scalability indicator pursuant to Article 22(2).
5. For reporting purposes, the indicators referred to under Title 7, 8 and 9 shall use the rolling historical set pursuant to Article 2(b).
6. For reporting purposes an average of values may be applied.

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Article 17
Request for change impact assessment

1. The request for change impact assessment should assess the impact on scalability by a request for change.
2. The assessment of the scalability indicator shall be performed for:

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a) the historical scenario: using as inputs the actual usage of all the existing functionalities as recorded over the whole year historical set under Article 2(c) and the anticipated usage of the functionality under assessment calculated over the near future set under Article 2(d) and applying the relevant thresholds in accordance with Article 22(2);
b) the near future scenario: using as inputs the anticipated usage of all the functionalities calculated on the near future set under Article 2(d) and using the relevant thresholds in accordance with Article 22(2).

Article 18
Scalability assessment

1. The scalability assessment should assess the impact of the long-term anticipated growth on the Co-optimisation algorithm scalability, considering the expected increase of usage of functionalities.
2. The relevant thresholds pursuant to Article 22(2) shall be applied on the values resulting from simulation of the SDAC algorithm including the anticipated usage of all functionalities on:

   a) the near future set pursuant to Article 2(d) and
   b) the distant future set pursuant to Article 2(e).

3. The usage range shall be calculated as the maximum usage of the functionalities supported by the Co-optimisation algorithm resulting from paragraph 2(b).

Article 19
Research and Development assessment

1. The research and development assessment should ensure the capability of the Co-optimisation algorithm to support in the medium and long term the anticipated market growth and the extension of requirements and shall use all performance indicators defined under Title 7.
2. The performance indicators shall be calculated with the usage range of all the functionalities when simulating the run of the Co-optimisation algorithm on the distant future set pursuant to Article 2(e) and shall be assessed as follows:

   a) for the scalability indicator the relevant thresholds in accordance with Article 22(2) shall be used;
   b) for the economic surplus indicator pursuant to Article 720 and the repeatability indicator pursuant to Article 821 the obtained values shall be assessed against the rolling historical set pursuant to Article 2(b).

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TITLE 7

Indicators on Co-optimisation algorithm performance

Article 20
Indicators on Co-optimisation algorithm's ability to maximise economic surplus

The indicators to monitor the ability of the Co-optimisation algorithm to maximize the economic surplus are:

1. **Economic surplus gain with respect to the first solution** – This indicator is the difference between the economic surplus of the accepted solution and the economic surplus of the first solution found. This indicator is not valid for comparing two different versions of the Co-optimisation algorithm. It should be used only as an indicative of the improvements of the solutions after first one is found.
2. **Economic surplus gain after increasing the calculation time by T minutes** – This indicator measures the gain in the economic surplus if the same delivery day is run again on a hardware with the same min requirements as the one used for delivering results, giving the Co-optimisation algorithm T minutes more. This indicator needs to be calculated ex post SDAC algorithm calculation, in a different process.
3. Economic surplus gain with respect to the first solution for the market side of the co-optimisation – This indicator is the difference between the economic surplus of the accepted solution and the economic surplus of the first solution found of the market side of the co-optimisation. This indicator is not valid for comparing two different versions of the co-optimisation algorithm. It should be used only as an indicative of the improvements of the solutions after first one is found.
4. Economic surplus gain after increasing the calculation time by T minutes for the market side of the co-optimisation – This indicator measures the gain in the economic surplus of the market side of the co-optimisation if the same delivery day is run again on a hardware with the same min requirements as the one used for delivering results, giving the co-optimisation algorithm T minutes more. This indicator needs to be calculated ex post SDAC algorithm calculation, in a different process.
5. Economic surplus gain with respect to the first solution for the balancing side of the co-optimisation – This indicator is the difference between the economic surplus of the accepted solution and the economic surplus of the first solution found of the balancing side of the co-optimisation. This indicator is not valid for comparing two different versions of the co-optimisation algorithm. It should be used only as an indicative of the improvements of the solutions after first one is found.
6. Economic surplus gain after increasing the calculation time by T minutes for the balancing side of the co-optimisation – This indicator measures the gain in the economic surplus of the balancing side of the co-optimisation if the same delivery day is run again on a hardware with the same min requirements as the one used for delivering results, giving the co-optimisation algorithm T minutes more. This indicator needs to be calculated ex post SDAC algorithm calculation, in a different process.

Article 21
Indicators on co-optimisation algorithm repeatability

1. The indicator to monitor algorithm repeatability reflect the differences of clearing prices and accepted quantities for different orders over the relevant MTUs and bidding zones between two runs of the co-optimisation algorithm. Potential differences shall be calculated while using the same inputs,

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configuration of hardware and software and at the same number of iterations and comparing the last common solutions in both runs.

2. The indicators to monitor algorithm repeatability reflect the differences, for market side of the co-optimisation, of clearing prices and accepted quantities for different orders over the relevant MTUs and bidding zones between two runs of the co-optimisation algorithm. Potential differences shall be calculated while using the same inputs, configuration of hardware and software and at the same number of iterations and comparing the last common solutions in both runs.
3. The indicators to monitor algorithm repeatability reflect the differences, for balancing side of the co-optimisation, of clearing prices and accepted quantities for different orders over the relevant MTUs and bidding zones between two runs of the co-optimisation algorithm. Potential differences shall be calculated while using the same inputs, configuration of hardware and software and at the same number of iterations and comparing the last common solutions in both runs.

Article 22
Indicators on co-optimisation algorithm scalability

1. The indicator to monitor algorithm scalability is the Time to first solution. This indicator measures the time spent since the algorithm starts until the first solution is found. It considers the time required for reading input data from database, the creation of the model for the optimisation problems and the resolution until the first solution has been found.
2. The scalability indicator pursuant to paragraph 1 shall be based on data sets in accordance with Article 2 and be assessed against the following thresholds (the 'x' and 'y' values shall be set in the algorithm monitoring procedure):
    a. In x% of the cases the indicator shall be lower than y minutes, and
    b. Its average value shall be smaller than z minutes.

TITLE 8

Indicators on the Co-optimisation algorithm usage

Article 23
Indicators to describe the usage of Co-optimisation products

1. Indicators on the evolution of the number of submitted orders of each product type in market side of the optimisation per bidding zone over time, and the corresponding total volume for the market:

    c) **Total number of steps at bidding zone level** – This indicator counts the total number of steps in the aggregated price-per-volume-curves for each bidding zone and MTU from all orders of all NEMO Trading Hubs. A step is a segment made of two consecutive curve points of the price-per-volume-curve with different quantities. One single value is provided per delivery day.

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d) **Total number of block orders** – This indicator counts the total number of block orders per delivery day and bidding zone.
e) **Total number of block order exclusive groups** – This indicator counts the total number of exclusive groups existing for the block orders per delivery day.
f) **Total number of linked families** – This indicator counts the total number of families of linked block orders per delivery day.
g) **Total number of complex orders** – This indicator counts the total number of complex orders per delivery day and bidding zone.
h) **Total number of scalable complex orders** – This indicator counts the total number of scalable complex orders per delivery day and bidding zone.
i) **Total number of demand merit orders** – This indicator counts the total number of demand merit orders per delivery day and bidding zone. These merit orders are not the PUN orders.
j) **Total number of supply merit orders** – This indicator counts the total number of supply merit orders per delivery day and bidding zone.
k) **Total number of PUN orders** – This indicator counts the total number of PUN orders per delivery day and biding zone. That means the number of unique PUN prices regarding the input data.

2. Indicators on the evolution of the number of submitted orders of each product type in balancing side of the optimisation per bidding zone over time, and the corresponding total volume for the market:

   a) Once it is available the list of products to be used for balancing side of the optimisation , this section will be updated with the list of products, following the same rules that set the list of indicators for the market side of the optimisation.
      i. Aggregated price-per-volume-curves for each bidding zone and MTU shall be provided as one single value per delivery day.
      ii. Different product types different than aggregated price-per-volume-curves shall be counted as the total per delivery day and bidding zone. If different sub-types exist, there will be reported
      iii. Product aggregation in groups or families shall be counted as the total per delivery day.

3. Indicators on the evolution of the number of submitted orders of each product type that sets links between the market and in balancing sides of the co-optimisation per bidding zone over time, and the corresponding total volume for the market:

   a) Once it is available the list of products to be used either for market side or balancing side of the optimisation by definition of links between these two market sides, this section will be updated with the list of links existing between these two sides, with the aim of transparently report the type and amount of existing links and following the same rules that set the list of indicators for the market side of the optimisation.
      i. Aggregated price-per-volume-curves for each bidding zone and MTU shall be provided as one single value per delivery day.
      ii. Different product types different than aggregated price-per-volume-curves shall be counted as the total per delivery day and bidding zone. If different sub-types exist, there will be reported
      iii. Product aggregation in groups or families shall be counted as the total per delivery day.

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Article 24
Indicators to describe the geographical extension of the Co-optimisation

Indicators on the evolution of the number of bidding zones:

a) **Number of bidding zones** – Total number of bidding zones. This indicator is obtained by counting all the bidding zones existing per delivery day.
b) **Total number of flow-based bidding zones** – This indicator counts the total number of bidding zones in which there is flow based topology. This indicator is calculated by counting the number of PTDF matrixes that exist per delivery day.
c) **Number of scheduling areas** – Total number of scheduling areas. This indicator is obtained by counting all the scheduling areas existing per delivery day.
d) **Number of NEMO Trading Hubs** – Total number of NEMO Trading Hubs per delivery day.
e) **Number of NEMOs** – Total number of different NEMOs in the delivery day. One NEMO may be operating several NEMO Trading Hubs, each one in a different bidding zone and scheduling area.
f) **Number of bidding zones** – making use of allocating cross-zonal capacity for the exchange of balancing capacity and sharing of reserves.

Article 25
Indicators to describe the network constraints

Indicators on the evolution of the use of network constraints are:

a) **Total number of bidding zone lines** – This indicator counts the total number of lines between bidding zones.
b) **Total number of flow-based PTDF constraints** – This indicator counts the total number of PTDF constraints existing for all the flow-based bidding zones per delivery day. It is the same as the number of rows in the PTDF matrixes.
c) **Total number of scheduling area lines** – This indicator counts the total number of lines between scheduling areas.
d) **Total number of NEMO Trading Hub lines** – This indicator counts the total number of lines between NEMO Trading Hubs.

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TITLE 9

Indicators on the Co-optimisation algorithm output

Article 26
Indicators to describe the output of maximization of economic surplus

Indicators on the maximization of economic surplus:

a) **Economic surplus of the first solution found -** is the market surplus, calculated Due to co-optimisation algorithm works floating-point format numbers, the precision of the calculations is limited. Quality of the solution is the quality in term of tolerances, using as value the worst level of tolerance achieved among all the checks applied to the constraints.

b) **Economic surplus of the final solution** - This indicator is obtained as provided by the co-optimisation algorithm, querying the utility of the solution that the co-optimisation algorithm classifies as the accepted solution per delivery day.

c) **Economic surplus of the first solution found for the market side of the co**-optimisation – is the market surplus, calculated due to co-optimisation algorithm works floating-point format numbers, the precision of the calculations is limited. Quality of the solution is the quality in term of tolerances, using as value the worst level of tolerance achieved among all the checks applied to the constraints.

d) **Economic surplus of the final solution for the market side of the co-optimisation** - This indicator is obtained as provided by the co-optimizoptimisation algorithm, querying the utility of the solution that the co-optimisation algorithm classifies as the accepted solution per delivery day.

e) **Economic surplus of the first solution found for the balancing side of the co-optimisation -** is the market surplus, calculated Due to co-optimisation algorithm works floating-point format numbers, the precision of the calculations is limited. Quality of the solution is the quality in term of tolerances, using as value the worst level of tolerance achieved among all the checks applied to the constraints.

f) **Economic surplus of the final solution for the balancing side of the co-optimisation** - This indicator is obtained as provided by the co-optimisation algorithm, querying the utility of the solution that the co-optimisation algorithm classifies as the accepted solution per delivery day.

Article 27
Indicators to describe the status of orders

1. Indicators on the evolution of number of matched orders and paradoxically rejected orders of each product type over time, and the corresponding total volume in market side of the optimisation;

   a) **Total number of matched blocks** – This indicator counts the total number of matched blocks per delivery day and bidding zone.

   b) **Total number of matched complex orders** – This indicator counts the total number of matched complex orders per delivery day and bidding zone.

   c) **Total number of matched scalable complex orders** – This indicator counts the total number of matched scalable complex orders per delivery day and bidding zone.

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d) **Total number of matched non-PUN merit orders** – This indicator counts the total number of matched merit orders (non-PUN merit orders) per delivery day and bidding zone. It will be calculated as the count of non-PUN merit orders whose matching quantity is greater than 0.

e) **Total number of matched PUN orders** – This indicator counts the total number of matched PUN orders per delivery day and bidding zone. That means the number of unique PUN prices regarding the input data. It will be calculated as the count of PUN orders whose matching quantity is greater than 0.

f) **Total matched volume from curves** – This indicator aggregates the total matched volume from supply and demand curves. It will be calculated as the sum of all "market time unit"-weighted unrounded volume matched at each relevant MTU and bidding zones for supply and demand curves.

g) **Total matched volume from blocks** – This indicator aggregates the total matched volume from blocks. It will be calculated as sum of all "market time unit"-weighted unrounded volume matched at each relevant MTU and bidding zones from blocks.

h) **Total matched volume from complex orders** – This indicator aggregated the total matched volume from complex orders. It will be calculated as sum of all unrounded volume matched at each relevant MTU and bidding zones from complex orders.

i) **Total matched volume from scalable complex orders** – This indicator aggregated the total matched volume from scalable complex orders. It will be calculated as sum of all unrounded volume matched at each relevant MTU and bidding zones from scalable complex orders.

j) **Total matched volume from (non-PUN) merit orders** – This indicator aggregates the total matched volume from (non-PUN) merit orders. It will be calculated as sum of all unrounded volume matched at each relevant MTU and bidding zones from (non-PUN) merit orders.

k) **Total matched volume from PUN orders** – This indicator aggregated the total matched volume from PUN orders. It will be calculated as sum of all unrounded volume matched at each relevant MTU and bidding zones from PUN orders.

2. Indicators on paradoxically rejected orders in market side of co-optimisation

a) **Number of PRBs in the final solution** – This indicator counts the total number of Paradoxically Rejected Blocks (PRBs) in the accepted solution per delivery day and bidding zone.

b) **Number of PRMICs in the final solution** – This indicator counts the total number of Paradoxically Rejected MICs (PRMICs) of the complex orders and scalable complex orders in the accepted solution per delivery day and bidding zone.

c) **Maximum Delta P in the final solution** – This indicator reports the maximum delta P of the blocks for the accepted solution per delivery day.

d) Maximum Delta MIC in the final solution – This indicator reports the maximum Delta MIC of the complex orders and scalable complex orders for the accepted solution per delivery day.

e) PRB utility loss in the final solution – This indicator reports the utility (economic surplus) loss due to paradoxically rejected blocks per delivery day.

f) PRMIC utility loss in the final solution – This indicator reports the utility (economic surplus) loss due to paradoxically rejected MICs and MPCs of the complex orders and scalable complex orders per delivery day.

g) Volume of PRBs in the final solution – This indicator sums the volume of all the Paradoxically Rejected Blocks (PRBs) in the accepted solution per delivery day and bidding zone.

h) Volume of PRMICs in the final solution – This indicator sums the volume of all the Paradoxically Rejected MICs (PRMICs) of the complex orders and scalable complex orders in the accepted solution per delivery day and bidding zone.

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3. Indicators on the evolution of number of matched orders and paradoxically rejected orders of each product type over time, and the corresponding total volume in balancing side of the optimisation;

   a) Once it is available the list of products to be used for balancing side of the optimisation, this section shall be updated with the list of indicators, following the same approach used for the list of indicators regarding the evolution of number of matched orders and paradoxically rejected orders of each product type over time, and the corresponding total volume in market side of the co-optimisationNumber of PRMICs in the final solution.

4. Indicators on paradoxically rejected orders in balancing side of co-optimisation

   a) Once it is available the list of products to be used for balancing side of the optimisation, this section shall be updated with the list of indicators, following the same approach used for the list of indicators regarding the paradoxically rejected orders, and the corresponding total volume in market side of the co-optimisation.

Article 28
Indicators to describe the IT calculation process

Indicators on the time spent in every phase of the algorithm calculation process are:

a) **Input data reading time** – This indicator measures the time the co-optimisation algorithm requires in order to read all the data needed for a delivery day from the SQL database. Different methods exist for the calculation of this indicator:
b) **Input data delivery day creation** – This indicator measures the amount of time the co-optimisation algorithm requires in order to create a delivery day from the data read from the database.
c) **Time to solve the root node for the master computer** – This indicator measures the amount of time to solve the root node for the master tree.
d) **Time to solve the root node for the job that found first solution** – This indicator measures the amount of time to solve the first node of the job that lead to the first OK solution found. This time will not include the time to read the input data and create the solver models. It will neither include the time spent in the master computers root node.
e) **Number of successive improvements of the solution in the given timeframe** – This indicator measures the number of OK solutions that improve a previously found solution during the optimisation process limited by the amount of time available for running the co-optimisatin algorithm.
f) **Total number of nodes in the master branch and bound tree** – This indicator measures the number of nodes processed in the master branch and bound tree.

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