European Network of
Transmission System Operators
for Electricity

Explanatory Document to the proposal of all Transmission System Operators performing the reserve replacement for the implementation framework for the exchange of balancing energy from Replacement Reserves in accordance with Article 19 of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing

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DISCLAIMER
This document is released on behalf of all Transmission System Operators performing the reserve replacement process solely for the purpose of public consultation for information only accompanying the RR TSOs' proposal for the implementation framework for the exchange of balancing energy from Replacement Reserves in accordance with Article 19 of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing.

1. Introduction

This document gives background information and rationale for the RR TSOs proposal for the implementation framework for the exchange of balancing energy from Replacement Reserves (this proposal is hereafter referred to as the "RR Implementation Framework" or "RRIF"), required by Article 19 (1) of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (hereafter referred to as "GL EB").

2. Explanation of the TERRE project and the governance structure

TERRE project is the implementation project for the RR-Platform with the scope of implementing a multi-TSO coordinated exchange of RR balancing energy to comply with the GL EB. The model for the Exchange of the Balancing Energy considered in this project will be the TSO-TSO model. The main objective of the TERRE project is to establish and operate a RR-platform capable of gathering all the RR standard products from TSOs' local balancing markets and providing an optimized allocation of RR, covering the TSOs' RR balancing energy needs. The implementation TERRE project approach started with a bottom-up approach. More specifically, the project started with harmonization of main principles instead of a full harmonization from the beginning[1].

The RR TSOs which currently participate to the TERRE project and the RRIF are: National Grid, Swissgrid, REE, REN, MAVIR, TERNA, Transelectrica, RTE and PSE. The current participating TSOs are using RR products for balancing purposes. ESO also joined the project TERRE in January 2018. The TERRE project remains open for new participants who would like to join the project as observer or as member.

The TERRE project members agreed to set up a consortium based on a signed legal agreement which is legally binding for all members. This consortium is designated to operate the RR-Platform functions described in the RRIF. The rules for the consortium governance will follow the principles explained in the RRIF. The next table presents the voting power of each member of the project based on the population distribution.

[1] The project TERRE with a reduced TSOs members scope (National Grid, RTE, REE, REN, TERNA and Swissgrid) conducted two European public consultation in 2016 and 2017.
The first consultation phase (2016) addressed mainly the TSO-TSO principles and showed the potential benefit of a common RR market.
Link: https://consultations.entsoe.eu/markets/terre/supporting_documents/20160307_TERRE_Consultation_FV.pdf
The second consultation phase (2017) clarified the common harmonized framework of TSO-BSP relations for the RR market.
Link:https://consultations.entsoe.eu/markets/public-consultation-document-for-the-design-of-the/supporting_documents/Consultation%20paper%20on%20TERRE%20design%20and%20RR%20market%20harmonization.pdf
Following each public consultation phase, two approval packages which contained the results of the stakeholders' feedbacks assessment were submitted to the related NRAs.
The NRAs expressed jointly their support to the TERRE project by publishing two "common opinion papers".

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TSO	Country	Population (thousands, 2016)	Population voting weight
NG	UK	65.637	22%
REE	Spain	46.444	16%
REN	Portugal	10.325	4%
RTE	France	66.896	23%
SG	Switzerland	8.372	3%
TERNA	Italy	60.601	21%
ESO	Bulgaria	7.128	2%
Mavir	Hungary	9.818	3%
Trans Electrica	Romania	19.705	7%

The cost sharing rules will be based on the principles as described in the RRIF. The next table represents the distribution of the costs between the TSOs, participation under the RRIF.

TSO	Country	Consumption GWh (2015)	Cost contribution %
NG	UK	27721	17%
REE	Spain	21909	14%
REN	Portugal	4080	6%
RTE	France	39617	22%
SG	Switzerland	5284	7%
TERNA	Italy	26194	16%
ESO	Bulgaria	2770	5%
Mavir	Hungary	3396	6%
Trans Electrica	Romania	4565	6%

The list of RR TSOs will be updated once a new Member will join the TERRE project or RR-Platform. These tables related to the cost contribution and voting weight will be updated on a yearly basis, once new data becomes available.

3. The roadmap and timeline for the implementation of the RR-Platform

The public consultation on the RRIF will take place between February and April 2018, and last for six weeks. The aim of the public consultation is to allow European stakeholders to provide their feedback on the RRIF to the TSOs. The TSOs will consider the stakeholders opinion and implement last amendments before the final submission of the RRIF to the NRAs for approval.

The submission of the RRIF to the NRAs will take place at the latest on 18th of June 2018, i.e. six months after entry into force of the GL EB. The RRIF package will consist of the RRIF document, the stakeholders' feedback, the detailed planning, the cost estimations in order to establish the RR-platform as the EU RR platform and an explanatory document elaborating on the main technical RR process.
The approval period by NRAs will start once the RRIF package has been submitted by the TSOs.

The go-live of the RR-platform is foreseen to take place one year after the approval of the RRIF, as required by the GL EB.

4. Functions of the RR-Platform

The RR-Platform shall consist of the following functions:

- **Activation optimisation:** please refer to section 7 of this document.
- **Data management:** this function is interfaced with the local TSO systems, feeds the AOF with the required information and receives from the AOF the expected outputs.
    - This component receives as inputs
        - RR standard products (CMOL description in the RRIF)
        - TSOs energy balancing needs (CMOL description in the RRIF)
        - Remaining cross-zonal capacity after the closure of the European Intraday market
    - This component generates for the TSOs the following results
        - Selected offers which should be activated by the TSOs
        - Satisfied TSOs balancing energy needs
        - Updated cross-zonal capacity parameters
        - Cross-zonal marginal prices
        - Cross-zonal commercial schedules
- **TSO-TSO settlement:** The financial settlement between TSOs based on the cross-zonal marginal prices procedure will be endorsed by this function. The harmonised rules for the TSO-TSO settlement will be described in the pricing, settlement and activation purposes proposal. In the section 12, some TSO-TSO settlement principles which will be implemented in the RR-Platform are described.

5. High-level design of the RR-Platform

The objective of the RR-Platform is to support the exchange of RR between RR TSOs that have at least one neighbouring RR TSO or Interconnected TSO (defined in the RRIF). The RR-Platform will gather all the RR offers from the TSOs' local balancing markets and provide, an optimised allocation of RR in order to meet the TSOs' balancing energy needs.

The TSO-TSO process is the following:

- The TSOs receive offers from the BSPs in their national market balance areas and systems.
- The offers which are coherent with the RR standard product are anonymized and forwarded to the RR-Platform (data management function described in section 4).
- TSOs applying a central dispatching model, pursuant to Article 27 of the GL EB, will convert integrated scheduling bids received from the BSPs into standard RR standard products and then submit the RR standard product to the RR-Platform.
- TSOs also communicate their balancing energy needs to the platform, as well as the available cross-zonal capacities remaining after the intraday market (data management function described in section 4).

- The RR-Platform executes the AOF (optimisation function described in section 4) that optimises the clearing of the TSOs' balancing energy needs against the BSPs' offers.
- The RR-Platform communicates back to the TSOs the accepted offers, the satisfied needs and the prices. Based upon this allocation of RR standard product, the platform calculates the commercial flows between the bidding zones. The resulting cross zonal schedules and updated cross-zonal capacities are sent to the TSOs and possibly also to the European verification platforms operated by ENTSO-E (data management function described in section 4).
- Data that must be published are sent to the central transparency platform operated by ENTSO-E according to the transparency 543/2013 regulation and article 12 of the GL EB (data management function described in section 4).
- Finally, the information required to settle expenditure and revenue between TSOs, i.e. the financial value of the energy flows across bidding zones, is sent to TSO-TSO settlement function responsible for the financial accounting between TSOs (TSO-TSO settlement function described in section 4).

6. Permitted RR standard product bid formats for balancing energy offers

The following RR standard product energy bids formats will be permitted in the RR-Platform:

(a) **Divisible offers with a minimum quantity greater or equal to one:** A divisible offer is a balancing energy offer that consists of a single quantity and a single price. Its delivery period can be 15, 30, 45 or 60 minutes. The algorithm can accept a part of it in terms of quantity; however, the same quantity must be accepted for the whole submitted delivery period. The BSPs can also define a minimum quantity. If the offer is accepted then always a volume greater or equal to this minimum quantity will be accepted.

(b) **Indivisible offers:** An indivisible offer is a balancing energy offer that consists of a single quantity and a single price. Its delivery period can be 15, 30, 45 or 60 minutes. The difference between a divisible and an indivisible offer is that the algorithm can accept either the whole quantity of the indivisible offer or nothing.

(c) **Exclusive offers either in time or in volume:** Exclusive offers are balancing energy offers that satisfy the following condition: only one (or none) of the exclusive offers can be activated; hence, the activation of a sub-offer belonging to an exclusive offer excludes the activation of the other sub-offers belonging to the same exclusive offer. The exclusive offers can either be divisible or indivisible offers. The number of sub-offers of each exclusive offer (that may be compounded of indivisible and divisible offers) will be limited by a maximum number that will be defined during the implementation phase, based on the computation time requirements.

(d) **Multi-part offers in volume:** A multi-part offer is a balancing energy offer that has variable prices for variable volumes and a single delivery period. The price can either decrease or increase as the volume increases.

(e) **Linking offers either in time or in volume:** Linking offers are balancing energy offers that satisfy the following condition: a sub-offer of a linking offer is (not) activated if and only if another sub-offer of the same linking offer is (not) activated. For the linking offers in volume, always the same ration of two linking offers will be activated.

Note: Some TSOs may not allow their BSPs to offer all RR standard product energy bids formats at the first stage of the operation of the RR-Platform, as their local IT systems may not be ready to process all types of offers. However, to ensure fair competition and non-discriminatory conditions, all BSPs will be allowed to offer all RR standard product energy bids formats at a later stage.

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7. TSO balancing energy need

The RRIF presents the harmonised definition of the TSO balancing energy need in Article 11. This section will explain the concept of TSO balancing energy need elasticity as well as the use of a tolerance band.

Elastic RR balancing energy need

A TSO can balance its area(s) with several balancing products, i.e. RR, mFRR, aFRR or specific products. Therefore, due to the fact a TSO has alternative measures to manage an imbalance, it is important for the TSO to have the ability to specify a price on the submitted need. This ability will remove uncertainties and allow the TSO to utilize available resources efficiently.

Note that today, the operators can choose with which product they balance their system, and hence they implicitly consider the prices of the different products when they submit imbalance needs. The ability to use a price on the need will lead to a higher amount of needs submitted to the RR platform, since it removes the incentive for the TSO not to submit needs due to the expectation of alternative measures being less costly. If this ability is not given, the TSOs will submit lower volumes to the RR platform and the opportunities for BSPs to be activated for RR will decrease.

The RR TSOs commit to coordinate the transparency level on the principles used to calculate the price of the balancing energy needs with the NRAs.

Tolerance band

The tolerance band is a parameter of the balancing energy need submitted by a TSO that reflects the willingness of the TSO to satisfy a higher absolute volume of the balancing energy need than requested with the submitted need, if this would increase the social welfare. In other words, it reflects the ability a TSO to receive more energy (resp. less energy) than what was requested in a submitted upward need (resp. downward need). Since a TSO bid can be divisible, there is no need to consider a tolerance band in the opposite direction to the submitted need. Note that the extra activated need due to the tolerance band shall not be included in the calculation of the social welfare.

The tolerance band will be used by the AOF only if it results in a higher social welfare. It is particularly useful when a large amount of indivisible offers are submitted, as flexibility reduces the number of Unforeseeably Rejected Bids. Note that if all submitted offers are divisible, then the need flexibility will not be used by the AOF. We illustrate this functionality by the following example.

Example: tolerance band

In this example, we consider only one TSO having a single elastic balancing energy need of 300MWh at 70€/MWh. The tolerance band is 50MWh. We also assume that there are two offers: an upward offer of 320MWh at 50€/MWh and a second divisible upward offer of 400MWh at 60€/MWh. In the first case (on the left side), the upward offer (UO) is divisible, whereas in the second case (on the right side) it is an indivisible offer.

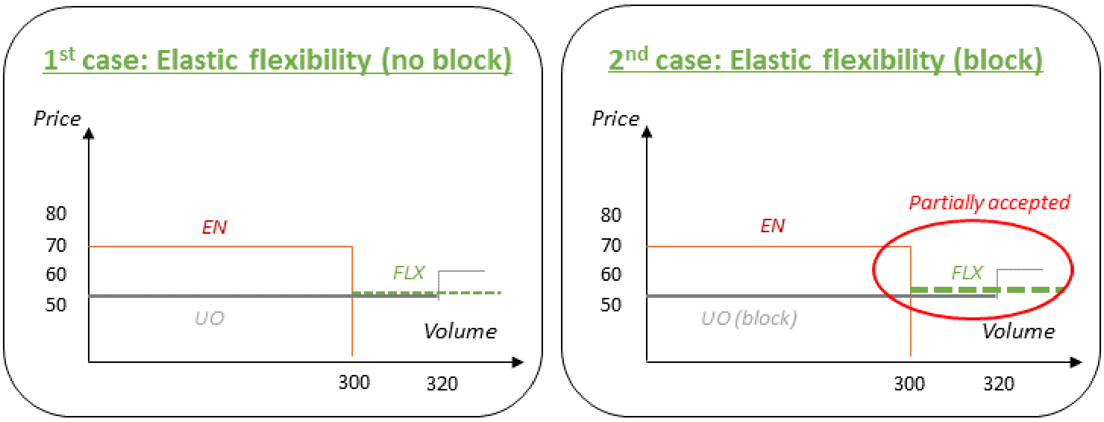

Figure: Example of tolerance band

In the first case, the existence of tolerance band on the elastic TSO balancing energy need is useless, as the algorithm will maximise the welfare without using the flexibility. Thus, the tolerance band is not used, and the TSO's balancing energy need is fully satisfied. The social welfare is equal to 6000€ and the marginal price is equal to 50€/MWh.

In the second case, the tolerance band of the elastic TSO balancing energy need allows the use of the UO indivisible, and increases the social welfare compared to the situation where the need was inflexible. In this case, the indivisible offer is fully accepted and the tolerance band is partially used (20MWh). Hence, the TSO has a satisfied balancing energy need of 320MWh. The social welfare is equal to 6000€ and the marginal price is equal to 50€/MWh.

Note that if the balancing energy need was not flexible, 300MWh from the second divisible offer would be activated. In this case, the social welfare would be equal to 3000€ and the marginal price equal to 60€/MWh. Therefore, the upward indivisible offer would be a URB.

8. Description of the optimisation algorithm

This section gives more explanation on the algorithm optimisation constraints.

8.1. Counter-activation

With the term counter-activations, we refer to the simultaneous activation of an upward and a downward offer in order to increase the social welfare. Due to the fact that all positive and negative TSO balancing energy needs, as well as all upward and downward balancing energy offers are treated in a single optimisation, counter-activations could occur if some downward offers had higher prices than some upward offers, i.e., if some BSPs would be willing to pay higher prices to reduce their production than the prices some other BSPs would be willing to receive to increase their production.

The figure below presents a merit order list. If a downward offer - illustrated with blue - has a higher price than an upward offer (illustrated with orange), then these two offers would be simultaneously activated, as this would result in a higher social welfare.

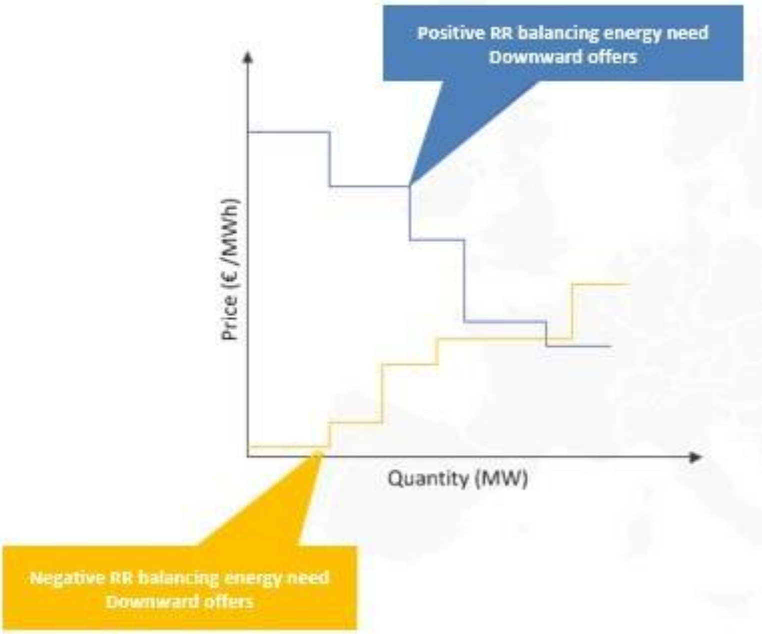

Figure: Counter-activations' explanation

The TSOs consider that allowing counter-activations increases the overall social welfare and offers more opportunities to market parties during the neutralization period of the European electricity markets. TERRE TSOs would like to point out that blocking counter-activation changes the objective function of the algorithm; in this case, the main objective is not the maximization of social welfare but the minimization of activations.

However, the TSOs take into account the stakeholders and NRAs concerns, reported during the previous interactions (consultation phases and stakeholders events), which are keener to block or minimise the counter-activation. Hence, the TSOs propose to monitor the frequency, the volume and the impact of counter-activations on cross-zonal marginal price, URBs, computational time and social welfare during the parallel run phase and a predefined operational period RR-Platform, as in the parallel-run phase not all RR TSOs expect to receive realistic bid prices. TSOs consider that the parallel run phase and this predefined period of the operational phase should provide additional guidance on the most beneficial approach.

Please note that some proposals, such as the NRAs one expressed in the common opinion paper following the last project consultations, aimed to minimise the counter-activation might not be technically feasible. More specifically, it may be challenging to combine the feedback of the stakeholders regarding Unforeseeably Rejected Bids (URBs), i.e. minimization of unforeseeably rejected divisible bids (please refer to the section 8.2), and a restriction of counter-activations; if we restrict counter-activations, we expect an increase of the URBs and an impact on cross-zonal marginal price. Therefore, a clear priority rule needs to be defined: either the restriction of counter-activations or the minimization of URBs will have priority in order for the AOF to decide which of the constraints will have to be respected and relaxed respectively. Therefore, in some cases, counter-activations will be allowed, if their restriction would result in a divisible URB, and in some other cases, they will be restricted. We would like to point out that this decreases the transparency of the process, and will influence the computational times.

If counter-activations will negatively impact the balancing market and the markets liquidity, the TSOs will reconsider their position and discuss this topic directly with NRAs and stakeholders. The TSOs suggest to define the predefined operational period introduced above to 6 months. The TSOs are open to discuss this period duration and the methodology to monitor counter-activation with the NRAs.

8.1.1. Impact assessment of allowing counter-activation on the marginal price

If the counter-activations are prevented, the marginal price will be affected in an un-predicted way; in some cases, the prevention of counter-activation may increase the marginal price, whereas in other cases it is expected to decrease the marginal price. In addition, it will result in the exclusion of upward (downward) offers with a lower (higher) price than the resulting marginal price, as depicted in Figure 1 and Figure 2. These offers are hence a part of the unforeseeably rejected offers described in section 8.1.2, but stem from the exclusion of counter-activations.

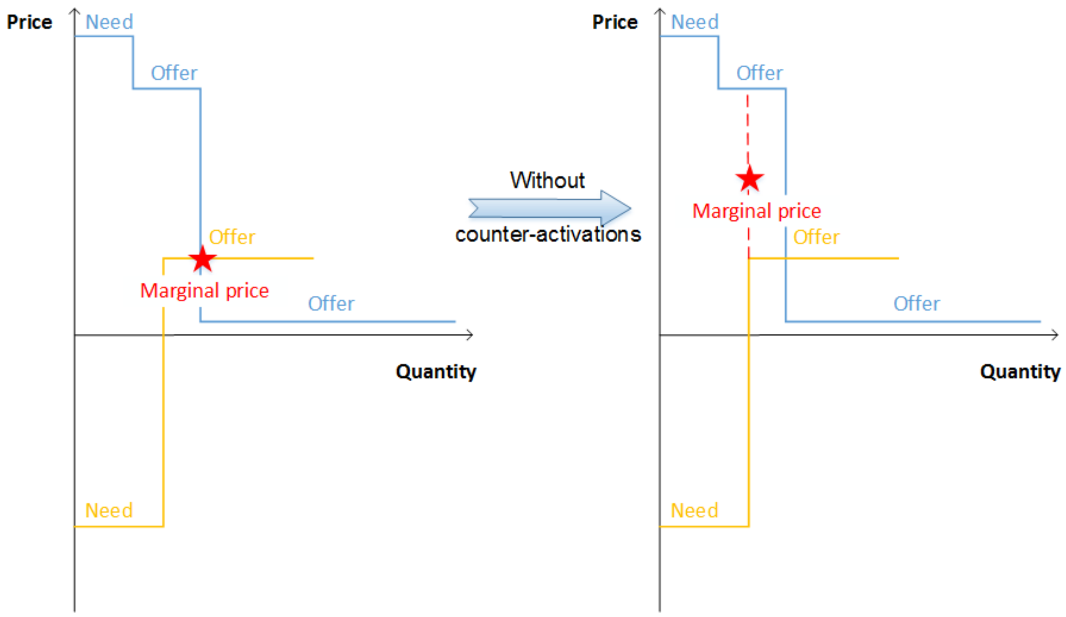

Figure 1: Exclusion of counter-activation increases marginal price

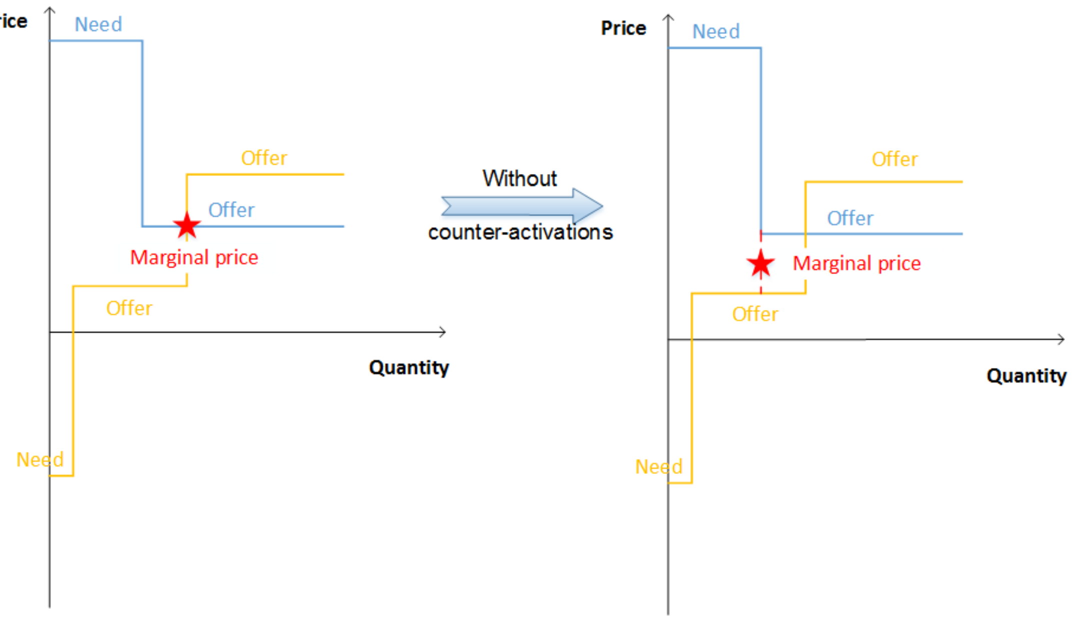

Figure 2: Exclusion of counter-activation decreases marginal price

8.1.2. Impact assessment of allowing counter-activation on the intraday market

In the previous interactions with stakeholders, concerns were raised regarding the impact of counter-activations on the intraday market. More specifically, it was expressed that the combination of an incentive gap through marginal pricing and a higher probability of activation on the RR-Platform through counter-activations could impact the intraday market liquidity.

The GL EB includes several references aiming at guaranteeing that the balancing markets do not endanger the efficiency of the previous markets such as the intraday.
Examples of such rules are the GCT, rules for updating the positions from the BRPs, rules for the submission of balancing offers to the European platforms, as well as pricing and settlement principles. These references will be followed by TERRE project in order to contribute to the efficient functioning of the energy markets (day-ahead/intraday). For example, RR TSOs aim at designing an efficient balancing market with a GCT not before the gate closure of the XBID Market, as foreseen by the GL EB. Therefore, the market participants shall prefer to make an offer to the XBID market and not wait for the RR market, as there will be more available transfer capacity. Moreover, the offers submitted to the RR-Platform shall be prequalified to fit the profile of the RR standard balancing product; this clearly differentiates them from the authorised bids of the intraday market. Therefore, due to aforementioned features, we believe that the allowance of counter-activations will not affect the liquidity of the intraday market.

8.2. Unforeseeably Rejected bids

The AOF seeks to optimise the social welfare of the TERRE region. In addition, not only divisible offers (with zero minimum quantities), but also more complex balancing energy offer formats are expected to be submitted. Therefore, there may be cases where a rejected upward (downward) balancing energy offer has a lower (higher) price than the marginal price. These offers are named unforeseeably rejected bids (URBs). The URBs might also occur in the case of Interconnection Controllability.

The RR TSOs have presented two options regarding URB:

1. allow unforeseeably rejected divisible bids
2. allow only unforeseeably rejected indivisible offers and minimize unforeseeably rejected divisible offers

Considering the feedback of the stakeholders and the consistency with other market timeframes, the RR TSOs aim to implement the second option. However, this option will impact (1) the complexity of the implementation, (2) the computation time of the algorithm and (3) the social welfare. For the implementation of this solution, i.e. minimization of the divisible URBs, the impact on the social welfare will be considered. This means that if the acceptance of a divisible bid and the rejection of an indivisible bid will have a high impact on the social welfare (exact number will be defined during implementation), the AOF will reject the divisible bid and accept the indivisible bid. The RR TSOs propose to monitor the complexity and the computation time of the algorithm during the parallel run phase. If it will be infeasible to find a solution satisfying the criteria of the second option within the acceptable time range, then the TSOs will implement the Option 1.

9. Treatment of HVDC and AC energy looses

Grid losses are a physical reality of both HVDC and AC grid. This implies that each allocation on a border with losses ends up with an allocation volume in the exporting area which differs from the allocated volume in the importing area. The AOF will consider the losses on the HVDC interconnectors, whereas losses in AC links will not be considered, as currently done by the day-ahead market coupling. The explanation below is compliant with day-ahead market coupling proposal.

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It was concluded that the optimal way to consider losses incurred by an exchange across HVDC interconnectors is to include them directly as an explicit constraint on cross-zonal exchanges in the AOF. More specifically, losses will be included in the overall supply and demand equilibrium constraints of the bidding zones with HVDC interconnectors, as illustrated in the figure below. In addition, losses are considered to be linear to the flow exchange, i.e., they are a fixed percentage of the scheduled exchange as specified by the operators and they are applied based on the overall interconnector loss value, unlike the value to mid-interconnector, as detailed below.

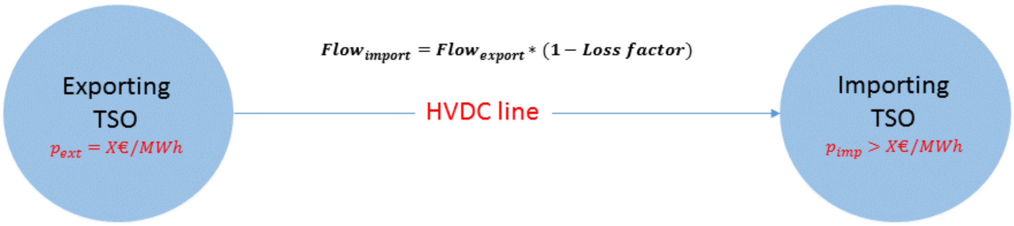


Figure: Losses in HVDC interconnectors

The high level properties on scheduled exchange, prices and congestion rent are the following:

- $Flow_{import} = Flow_{export} * (1 - loss\ factor)$
- $P_{import} * (1 - loss\ factor) - P_{export} = 0$ when no congestion and there is no congestion rent, even if there is a price differential.
- $P_{import} * (1 - loss\ factor) - P_{export} > 0$ when the line is congested and thus there is a congestion rent, calculated as: $P_{import} * Flow_{import} - P_{export} * Flow_{export}$

Note that this does not hold for adverse flows, i.e. flows from a more expensive to a cheaper area that may occur due to e.g., interconnectors' controllability constraints.

For IFA, as the algorithm does not recognize the mid-channel reference, we consider the IFA combined Loss Factor equal to 1 - (1-LF) / (1+LF), with LF being the Loss Factor at mid-channel.

The social welfare is also decreased by those losses that can be calculated as:

$$\sum_{all\ interconnectors} (Flow_{export} * p_{export} - Flow_{import} * p_{import})$$

Those financial costs of HVDC losses are therefore implicitly borne by all TSOs members (not always proportionally though), as the consideration of losses directly affect the prices in the respective borders.

10. Interconnection controllability

The calculation of the capacity offered to the market is fundamentally different between AC and DC borders. On DC borders (within the GB market and elsewhere) the nameplate rating is generally offered into the market (i.e. no capacity is held in reserve to cater for faults, operational issues etc.). However this is not the case for AC borders where capacity can be reduced to cater for operational requirements (e.g. n-1).

For DC borders, this can lead to times where the market benefit that the extra capacity brings is outweighed by the operational costs of providing the capacity. Therefore, to avoid such situations and maximize social welfare, TSOs need to manage HVDC links in operational timescales as certainty of power system conditions increases. TERRE allows these TSOs to manage HVDC links by submitting to the RR-Platform a desired flow range across the HVDC.

The TERRE TSOs decided to extend this functionality which was first considered for HVDC links also to AC borders and implement interconnection controllability within RR-Platform. As opposed to current explicit counter-trading[2] where the cross-zonal exchange is initiated by system operators between two bidding zones to relieve physical congestion, this change in cross-zonal exchange is implicitly converted as a constraint in the algorithm. Each TSO defines hence new bounds for the bilateral commercial exchange for the border to be controlled. If the new bounds are respected by reducing the available capacity across the respective border, the available capacity reduction is done before the RR-Platform process, in the same way as today. However, if a reversal of the exchange is required to respect the new bounds, the TSO can define a minimal desired exchange in a specific direction (i.e. a negative capacity). The AOF constrains the flow across the specific border, considering the desired exchange submitted by the TSO. Note that this is a hard constraint; therefore it will be respected irrespectively of the cost.

The offers that will be accepted by the optimisation algorithm, and hence, will be activated, will respect the constraint of the desired exchange. However, the settlement between TSOs will be done based on the marginal prices resulting from the algorithm without considering the desired exchange constraints. The accepted offers activated to respect the constraint of the desired flow range (and not accepted without considering such constraint) will be paid to the BSPs based on pay-as-bid aiming to comply with Article 30 of the GL EB.

We consider the following example to explain the aforementioned activations and settlement option.

Example:

We consider the system depicted in Figure 1 below and the offers presented in Table 1 below. For the sake of simplicity, all offers and needs have a validity period equal to the market time unit, i.e. 60 minutes, and all needs are considered to be inelastic and inflexible. The cross-zonal capacity between TSOs 2 and 3 is large enough so as not to influence the results, whereas the submitted cross-zonal capacity between TSO 1 and 2 is 50MW for the one direction (1 -> 2) and 0MW for the opposite direction (2 -> 1). As illustrated in Figure 1Figure 2, TSO 1 submits a desired minimum flow of 30MW.

Figure 2: Example Interconnection Controllability

TSO	Offer direction	Offer quantity (MW)	Offer price (€/MWh)
1	Upward	40	50

[2] As allowed in the commission regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management.

1	Upward	50	60
2	Upward	60	60
2	Downward	50	-35
3	Upward	80	30
3	Upward	90	40
3	Downward	50	-5

Table 2: Example Interconnection Controllability: submitted offers

The AOF considers the desired flow of 30-50MW and gives the results presented in Figure 2 and Table 2 below.

Figure 2: Example Interconnection Controllability: results

TSO	Offer direction	Offer quantity (MW)	Offer price (€/MWh)	Activated quantity (MW)
1	Upward	40	50	40
1	Upward	50	60	10
2	Upward	60	60	0
2	Downward	50	-35	0
3	Upward	80	30	70
3	Upward	90	40	0
3	Downward	50	-5	0

Table 2: Example Interconnection Controllability: activated offers

The AOF will be executed once more (sequentially or in parallel with the first run), without considering the minimum desired flow constraint. The results of the second unconstrained run are presented in Figure 3 and Table 3 below.

Figure 3: Example Interconnection Controllability: results of unconstrained run

TSO	Offer direction	Offer quantity (MW)	Offer price (€/MWh)	Activated uantity (MW)
1	Upward	40	50	20
1	Upward	50	60	0
2	Upward	60	60	0
2	Downward	50	-35	0
3	Upward	80	30	80
3	Upward	90	40	20
3	Downward	50	-5	0

Table 3: Example Interconnection Controllability: accepted offers in the unconstrained run

The price at the bidding zone of the TSO 1 will be 50€/MWh, and the price at the bidding zones of the TSOs 2 and 3 will be 40€/MWh. Note that the accepted offers of the constrained run, presented in Table 2, are activated but the marginal price is the result of the unconstrained run.

As aforementioned, some uplifts will be given to BSPs that were activated but had higher submitted price for upward offers (or lower submitted price for downward offers). More specifically, these BSPs will be paid with pay-as-bid. In the above example, this holds only for one offer: from the area of TSO 1, an offer with submitted price 60€/MWh was activated, but the marginal price is 50€/MWh. This offer will thus be paid with 60€/MWh instead of 50€/MWh. Note that this offer belongs to the TSO 1 who requested the Interconnector Controllability, and will hence not affect the TSO-TSO settlement. The uplift given to this BSP, i.e. 60€/MWh·10MW–50€/MWh·10MW=100€, will come from the TSO 1 who requested the controllability.

The TSOs will be transparent on the interconnection controllability usage. The TSOs also consider that any potential "missed activations" due to the consideration of the interconnection controllability are linked to the security of network which is under the mandatory responsibility of the TSOs.

11. Unavailable offers:

Unavailable offers refer to offers submitted by the BSP that have been flagged by the local TSO and are therefore blocked from being activated by the platform. The reasons for marking a offer unavailable are:

- For local congestion issues: the activation of the offer will somehow endanger the grid situation locally if activated.
- For local lack of margin: the activation of this offer by other TSO will alter the margin reserve of the TSO and would result in the activation of exceptional or emergency resources in order to replace them. An example might be offers with a limited amount of energy per day, which might have to be reserved by the TSO to ensure enough margin for high demand period during the day.
- For fulfilling the local requirements for Frequency Restoration Reserves with manual activation (mFRR) or Frequency Restoration Reserves with automatic activation (aFRR).

The TSOs will not use these principles expressed in this section to achieve any economic benefit and they will align the transparency on this topic with the NRAs and stakeholders by respecting the GL EB Article 12 on Publication of Information requirement.

12. TSO-TSO settlement

As a consequence of the exchange of balancing energy in RR-Platform, there will need to be a settlement mechanism between the TSOs.
The key features of the TSO-TSO settlement are:

- Settlement of the energy exchanged based on pay-as-cleared , following the guidance provided by the GL EB
- The energy commercially scheduled and settled between the TSOs will be the energy block over the corresponding period (not including the possible energy associated to the ramps outside the period, in line with the definition of standard product for RR by ENTSO-E (see Figure 1).

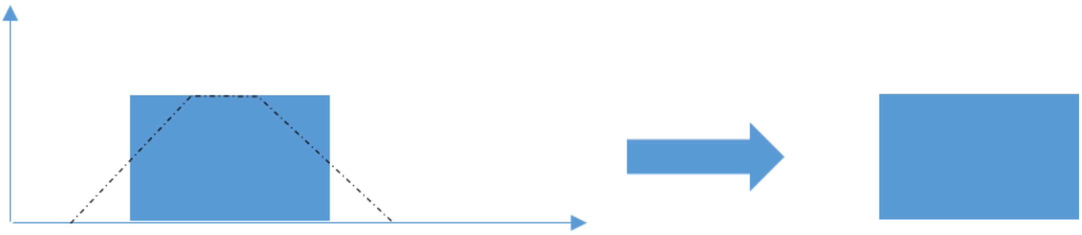


Figure 1: Energy volume scheduled and settled at cross-zonal level in TERRE

12.1. Congestion rent

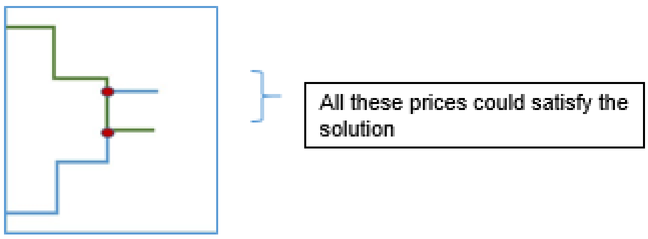
There could be situations where borders within RR regions become congested. In such a case, there could be different marginal prices on each interconnected bidding zone. Each of these prices will be established based on the activated balancing offers and/or the satisfied TSOs balancing energy needs in the non-congested area. Due to this price difference between the price that an area is "willing to pay" and the price that the other area is "willing to receive" at either side of the interconnector, a surplus will occur. This surplus, calculated as the multiplication of the exchanged balancing energy times the price difference, is called a "congestion rent" in other timeframes (such as the MRC project). In this case, the " RR congestion rent" would be:

RR congestion rent = RR schedule x (ΔPrice)

The RR schedule is the cross-zonal schedule between the two congested areas and ΔPrice the difference of marginal prices at both sides. The distribution of congestion rents is a regulatory issue that shall be established with the input from the NRAs. These congestion rents do not only occur in the RR-Platform but also in other timeframes (e.g. Multi Regional Coupling in DA). Therefore the use of this congestion rent will be consistent with how it is used in other timeframes, and in line with the Regulation R 714-2009 article 16-6.

12.2. Price indeterminacy

A Price indeterminacy is a special situation when identical bid and demand selection lead to multiple optimal clearing price solutions, as depicted the figure below. In this case, all solutions have an identical social welfare and is therefore necessary to define a rule to choose a single price between the set of optimal prices. This situation can occur either due to the presence of elastic demands or due to scheduled counter-activations.



To calculate the price, the mid-point between the lowest and the highest possible price will apply. This approach would be consistent with the current practice in the day-ahead market coupling. Note that both the activated and not activated offers/TSO balancing energy needs are taken into account. This is represented in the Figure 1 below.

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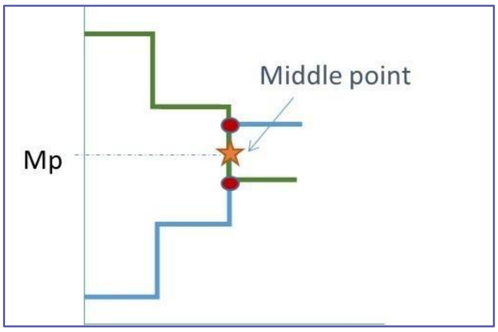

Figure 1: Indeterminacies in price: Middle price

13. Cross border scheduling steps and number of daily gates

The TERRE TSOs commit to reduce the cross border scheduling steps less than 60min for the borders included in the RR region. The target will be the GL EB required date of implementation of the European Platform for exchange of mFRR. From this deadline, the cross border scheduling step will be 15min.
Starting from this date, some TSOs are likely to increase the number of daily gates (daily clearing) to 48 and 96 gates. For example, RTE and Swissgrid aim to implement 48 daily gates.

Depending on the maturity of the European balancing market at that time, TSOs will perform an analysis on the increase of daily gates.

14. Fall-back process

In the event that the optimisation algorithm does not converge, the following fall-back procedure will be performed:

1. The algorithm will run taking into account the previously submitted balancing energy offers and TSO balancing energy needs, requirements and other constraints, with cross-zonal capacity between all bidding zones equal to 0;

2. The final results will be communicated to the TSOs,

Furthermore, each TSO shall ensure that national fall-back solutions are in place in case the procedures referred to in paragraphs (1) and (2) fail. Thus, if the algorithmic optimisation does not converge with cross-zonal capacity equal to 0, all TSOs will run their national systems, taking into account only their national balancing energy offers and balancing energy need, requirements and other constraints, and, in this case, the TSOs' balancing energy needs will be satisfied only through national offers.
Each TSO can decide to use the national fall-back solution or the solution provided by RR-Platform fall-back procedure.