European Network of
Transmission System Operators
for Electricity

Proposal for standard products

- draft -

Working Group Ancillary Services

1. ABSTRACT

Operating power systems, including performing balancing at the lowest cost and the best security of supply level is one of the targets of the third energy package. A prerequisite of a European wide competitive balancing energy market is the definition of rules and criterions to harmonise balancing services expected from Balancing Service Providers (hereinafter "BSP").

This work was begun several years ago based on Framework Guidelines on Electricity Balancing defined by ACER, which was then applied by ENTSO-E in a proposal for a European regulation. This proposal was covered in an opinion issued by ACER on 20th July 2015. It is on this basis that the European Commission is now working so that it can submit to its Member States a draft text – the Guideline on Electricity Balancing (hereinafter "EBGL") – as part of the comitology process.

The current version of the EBGL requires that standard balancing energy and balancing capacity products have to be defined no later than six months after the entry into force of this regulation. The early definition of these products will allow both TSOs and BSPs to consider them in their relevant processes in order to be prepared for the introduction of European platforms for promoting the exchange of balancing services.

Starting from the current situation where European TSOs use hundred of products for balancing energy and balancing capacity which are usually close to each other but not really comparable, a subgroup of the Working Group Ancillary Services has defined a first set of standard products for balancing energy and balancing capacity to fulfill the EBGL requirements. By circulating this set now, ENTSO-E aims at discussing its proposal with stakeholders, before launching a public consultation and submitting the set of standard products to ACER, as requested by the EBGL. Of course, the high level principles mentioned throughout this document will need to be futher refined before the establishment of European platforms. In any event, it should be kept in mind that the EBGL allows and promotes the periodic revision of standard products. Therefore, depending on learnings from early implementation projects, feedbacks from stakeholders, future ENTSO-E definition of processes, this set of standard products could be reviewed at any point in time if needed, or at least every two years according to EBGL.

The inputs considered for this document are: (i) the EBGL, (ii) the Framework Guidelines, (iii) the Key policy issue paper, and (iv) the Guideline on Electricity Transmission System Operation (hereinafter "SOGL"). From these inputs, the subgroup studied or highlighted many technical points in terms of physical and financial consequences for TSOs, BSPs and BRPs. For each of them, the subgroup tried to identify in a comprehensive manner the different options and provide a conclusion or a recommendation for the definition of standard products.

The current document deals with balancing energy standard products (manual and automatic) which mainly differ in the full activation time and the activation process. ENTSO-E reminds the historical evolution of balancing energy standard products. Indeed initially there were 9 manually activated balancing energy standard products. Over the past months, ENTSO-E has taken into account ACER, EC and stakeholder remarks in order to improve its definitions, reduce the number of balancing energy standard products and reach the most acceptable compromise solution. The following set of balancing energy standard products satisfies most of TSOs needs to solve system imbalances.

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2. CONTENT

3. INTRODUCTION

The current version of the EBGL requires that standard products for balancing energy and balancing capacity have to be defined no later than six months after the entry into force of this regulation. The EBGL actually promotes the harmonisation of balancing energy and balancing capacity products used by TSO in order to create a wide European balancing market. Such a market should increase competition and reduce balancing costs in the long term. A standard product finally consists of a balancing energy (or capacity) bid with characteristics predefined and which should be used to solve most of the needs of European TSOs.

This document only deals with standard products for balancing energy (automatic and manual Frequency Restoration Reserves and Replacement Reserves balancing energy products). It should be pointed out that Frequency Containment Reserves products are out of scope because (i) the characteristics of these products are sufficiently defined in the Guideline on Electricity Transmission System Operation (hereinafter "SOGL") and (ii) the Framework Guidelines on Electricity Balancing do not refer to the *balancing energy* from *frequency containment reserves*.

The reason why standard products for balancing capacity are not tackled at this stage are numerous. This is partly because while the exchange of balancing energy is mandatory in accordance with the EBGL, the exchange of balancing capacity is voluntary. Moreover, the product definitions of Balancing Capacity are more complex, and will in any case depend on the Balancing Energy products. In other words, it is necessary to first clearly define standard products for balancing energy before looking at standard products for balancing capacity.

4. TARGETS AND TIMEFRAMES

4.1 Targets

The EBGL promotes the introduction of standard products in order to enhance competition between BSPs. Such a principle means that the majority of BSPs should be able to participate, should they be from conventional units, renewable units, demand side or any other reserve providing unit. From a TSO side, a wide and competitive market should be reached to cover the TSO balancing needs.

The article 25.6 summarizes this requirement in: "*Standard Products for Balancing Energy and Balancing Capacity shall:*

> *(a) ensure an efficient standardization, foster cross-border competition and liquidity, and avoid undue market fragmentation;*
>
> *(b) facilitate the participation of demand facility owners, third parties and owners of power generating facilities from renewable energy sources as well as owners of storage elements as balancing service providers;*
>
> *(c) satisfy the needs of TSOs in order to ensure operational security and efficiently fulfil frequency Quality Target Parameters and reserve capacity requirements pursuant to Article 127, Article 157, and Article 160 of Commission Regulation (EU) 2017/00 [SO].*

Conclusion

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- ENTSO-E defines the standard products in accordance with TSO needs and in order to respect *Commission Regulation (EU) 2017/00 [SO]*, in line with Article 25.6.c.
- Proposal of standard product is from TSO point of view, also in line with articles 25.6.a and 25.6.b but should be discussed in detail with stakeholders in order to receive their feedback and proposals for possible improvement.

4.2 Timeframe for definition of standard products

The EBGL requires that standard products should be proposed by six months after entry into force of the regulation (article 25.2).

4.3 Timeframe for implementation of standard products for balancing energy

The timeframe for implementation and use of these standard products for balancing energy is defined through the Chapter 2 “European platforms for the exchange of balancing energy” and especially within Articles 20, 21 and 22. These Articles indicate:

- 2 years after entry into force of the EBGL for RR balancing energy product(s) ;
- 4 years after entry into force of the EBGL for mFRR balancing energy product(s) ;
- 4 years after entry into force of the EBGL for aFRR balancing energy product(s).

5. STANDARD PRODUCTS

A standard product means a harmonised balancing product defined by all TSOs for the exchange of balancing services. Balancing services means either or both balancing capacity and balancing energy.

Throughout the remainder of the document, focus is on balancing energy, which means energy used by TSOs to perform balancing and provided by a BSP. Balancing energy can be provided by assets (either power plants, demand response or storage units) which were contracted by TSOs for balancing capacity as well as "free" assets (ie : non-contracted assets).

5.1 Definition of standard products characteristics

5.1.1 General characteristics

The key characteristics of standard products are listed in article 25 of the EBGL and their meaning is detailed below. Two other characterics were added by TSOs to better describe standard products.

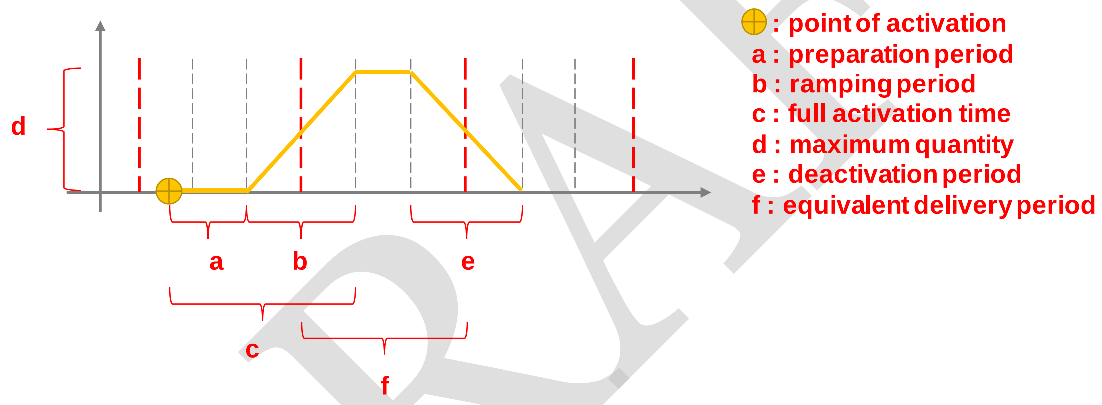

Figure 1 : General characteristics

Preparation Period (EBGL, definitions)

It means the time duration between the activation request by the TSO and start of the energy delivery.

Ramping Period

It means the time duration between the start of the energy delivery and the corresponding full activation of the concerned product.

Full activation time (EBGL, definitions)

It means the time period between the activation request by TSO and the corresponding full activation of the concerned product.

Preparation period, ramping period and full activation time are complementary values. Therefore, when defining two of these values, the entire timing of the product is clear and defined. When offering flexibility, each BSP will be entitled to split this time duration into a preparation period and a ramping period.

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The full activation time will be verified for prequalification of bids, while preparation and ramping periods will be at least required for information for the connecting TSO but not necessarily used.

Minimum and maximum quantity

It means the power (or change of power) which is offered in a bid by the BSP and which will be reached at the end of the full activation time. The minimum (maximum) quantity represents the minimum (maximum) amount of power for one bid.

Deactivation period (EBGL, definitions)

It means the period for ramping down, from full delivery or withdrawal back to a setpoint.

Minimum and maximum duration of delivery period (EBGL, definitions)

It means the minimum (maximum) time period of delivery during which the BSP delivers the full requested change of power in-feed or withdrawals to the system.

Minimum and maximum duration of equivalent delivery period

It means the energy which is requested by the TSO divided by the maximum power which is requested. Therefore it gives the length in time of the TSO's energy request.

Validity period (EBGL, definitions)

It means the time period when the balancing energy bid offered by the balancing service provider can be activated, whereas all the characteristics of the product are respected. The validity period is defined by a beginning time and an ending time.

More precisely, it means the time period for which a balancing energy bid is submitted by a balancing service provider.

In order to deal with a combined product that could be either scheduled or direct activated, ENTSO-E suggests to add one definition to define directly activated products: <u>the full validity period</u>.

The full validity period would correspond to the sum of the validity period of the bid and fifteen minutes (15 minutes before the validity period or 15 minutes after depending on the final process).

The following figure illustrates this definition.

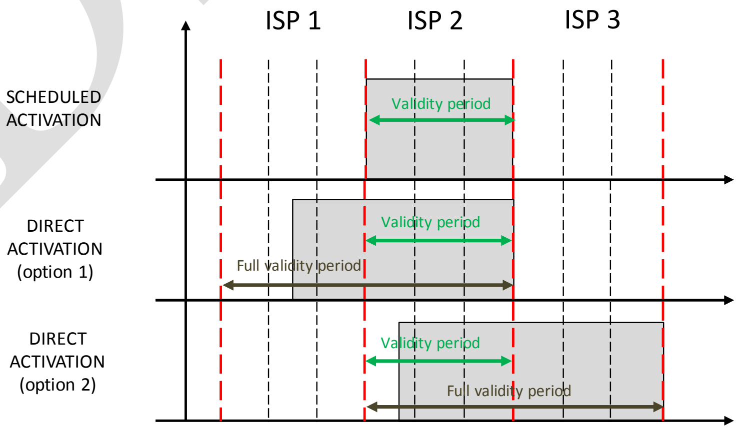

Figure 2 : Concept of the full validity period

Mode of activation (EBGL, definitions)

It means the implementation of activation of balancing energy bids, manual or automatic, depending on whether balancing energy is triggerred manually by an operator or automatically in a closed-loop manner.

Point of activation

The point of activation is the point in time where BSPs get the information that they have been activated. For SCH bids, the time of activation starts at a fixed point in time whereas for DA bids, the time of activation could start at any point.

5.1.2 Variable characteristics to be determined by balancing service providers

5.1.2.1 Price of the bid

The price of one bid could be either positive or negative and has to respect the terms and conditions related to balancing.

5.1.2.2 Direction of the bid

The direction of one bid could be either upward or downward and shall be defined by the BSP.

5.1.2.3 Divisibility

Divisibility refers to divisibility in volume of one bid. Divisibility in time is covered by different parameters.

A bid is **named "divisible"** when the minimum quantity and the maximum quantity are different value giving more flexibility to TSOs who can activate the BSP to a value included in the range [minimum quantity of the bid; maximum quantity of the bid] or [0; quantity of the bid].

A bid is **named "non-divisible"** when the TSO can only activate to "one single value" for the bid.

5.1.2.4 Location

The bid location is a key information for the activation optimization function and the connecting TSO. Indeed, the bid selection algorithm will need to comply with operational security limits and more specifically the cross-zonal capacities and possibly internal constraints. Therefore the minimum information required for the location value is the bidding zone. In addition, it has been underlined that some bidding zone are wide and include many TSOs, therefore we propose to complete the location information with connecting TSO name. Moreover, depending on the design of the local market (number of bidding zones, central dispatch versus self dispatch, portfolio bidding …) additional information may be needed and requested by the connecting TSO in order to efficiently balance its system and manage local network congestions.

5.1.2.5 Links between bids

During the discussions held within ENTSO-E, it has been highlighted that it would be beneficial to allow proposing bids which are linked together in terms of power (two bids available during the same validity period) or in terms of time (two bids with different validity period).

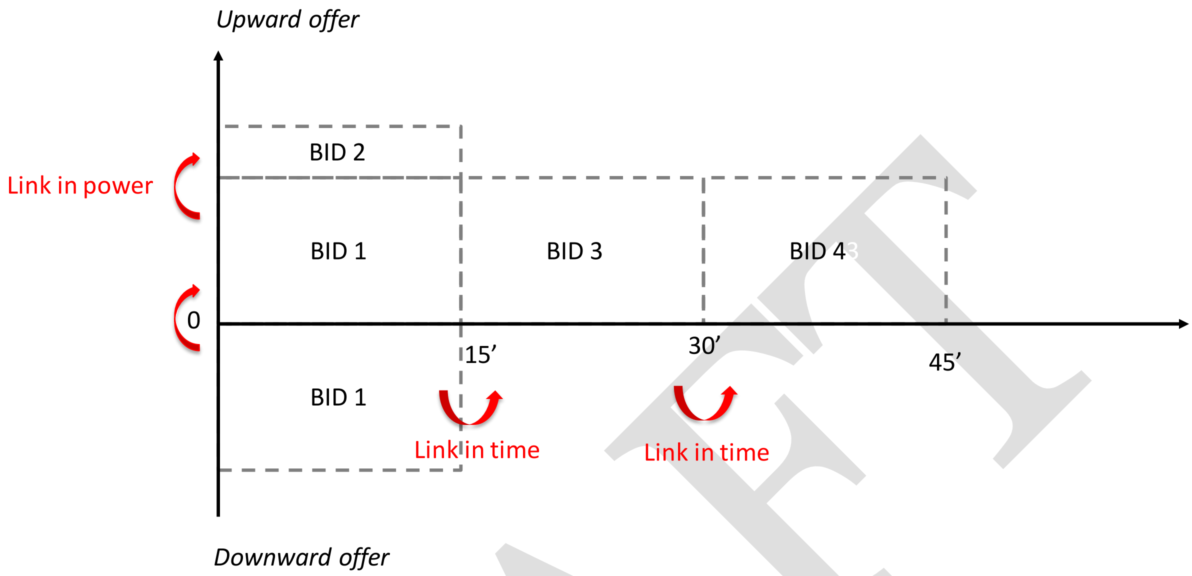

Figure 3 : Possible links between bids

Different types of links have been discussed **such as**:

- Link between bids to generate "group of offers": this link means that a bid could be activated only if another or others are also activated Example : If bid "1" is activated, then bid "2" and "3" should be activated (necessary activation of 3 bids in one shot);
- Link of exclusivity: this link means that the activation of a list of bids is mutually exclusive (only one can be activated). If bid "1" is activated, then bid "2" is unavailable (exclusive choice between bid "1" & "2").

The links between bids allows:

- BSP to manage their starting costs and describe the power limits of generation units when needed (e.g. price of bid "1" is 70 €/MWh and include a starting cost of 1000 € while price of bid "2" is only 50 €/MWh. There is no starting cost, only energy but the use of this bid is contingent on the previous activation of bid "1");
- BSP to manage energy constraint when offering their bids (e.g. for a bid able to deliver 100 MWh, BSP could offer bid "1" at 400 MW during 15 minutes or bid "2" at 200 MW during 30 minutes. BSP do not ex ante know which one of these bids will be activated by the TSO, linking bids together increases flexibility);
- BSP to clearly describe the availability of flexible assets which can be both scheduled or direct activated when they are offered for multiple adjacent periods (e.g for a BSP able to be "directly" activated on a time period only if he has not been scheduled activated during the previous time period).

The links between bids could finally allow BSPs to offer more flexibility, maximise the opportunity to be activated by fitting with TSO needs, reduce costs of balancing and contribute to an efficient and competitive balancing market. However links between bids generate complexity for the algorithms of the different activation optimization function.

Therefore the possibility to link bids should be studied and defined in each implementation project (as made for RR product). The following principles should be respected:

- the possibility to link bids between different processes (and therefore products) will not be authorized in a first step. Depending of needs, easiness to implement and benefits, this proposal could be reconsidered in ongoing proposal for evolution of standard products and algorithms;
- the links between bids are only allowed for those bids which can be activated in the time interval between two intraday cross zonal gate closure time, and not between bids which could overlap with intraday. Indeed the selection process of bids only refers to the bids offered for the next balancing period (i.e. after intraday GCT until the next one) and no links between several periods will be considered for simplicity reasons;
- the possibility to link bids and the number of links should not affect too much the complexity of the selection process and the clearing time duration of the clearing algorithm.

5.2 Proposal for a list of standard products for balancing energy

5.2.1 Manual standard products

Based on the characteristicts detailed above, ENTSO-E proposes a set of two manual standard products for balancing energy.

5.2.1.1 Preparation period

For the two manual products proposed the preparation period should be between 0 and the full activation time.

Conclusion:

	All products
Preparation period	**From 0 to full activation time**

5.2.1.2 Ramping period

For the two manual products proposed the ramping period should be between 0 and the full activation time. However, TSOs or groups of TSOs together can define specific requirements to ramping in their system as deemed necessary.

Conclusion:

	All products
Preparation period	From 0 to full activation time
Ramping period	**From 0 to full activation time**

5.2.1.3 Full activation time

SOGL provides many requirements to be respected in order to manage the system while respecting frequency quality targets and is thus considered as an input to design standard products. Indeed TSOs shall restore system frequency and energy exchanges after a fixed period of time following an expected or unexpected event. This time target is called Time To Restore Frequency (hereinafter “TTRF”) and will be harmonized at 15 minutes throughout Europe according to SOGL. Standard products that help to respect the TTRF requirements are called Frequency Restoration Reserve (hereinafter “FRR”) products.

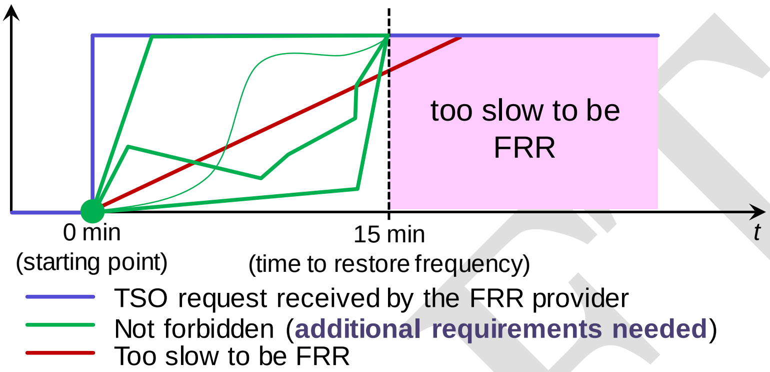

Figure 4 : Definition of a FRR product

Thus, the full activation time for the mFRR product has to be fast enough to respect TTRF. Among TSOs, there is still some lack of clarity regarding the requirements the SOGL imposes on the FAT of this mFRR product, in other words on what is exactly meant by “fast enough to respect TTRF”. At least two possible interpretations of the current rules were identified by TSOs and are detailed in the appendices. To sum it up, with interpretation 1, FAT of the mFRR product could be equal to 15 minutes whereas with interpretation 2, FAT of the mFRR product has to be strictly lower that 15 minutes.

These two interpretations lead some TSOs to propose a FAT of 15 minutes and others a FAT of 10 minutes.

Nevertheless, a merging of these two products seems reasonable:

- It would reduce the number of products;
- If a FAT of 15 min would not comply with TTRF the merging of these two products could solve the problem depending on the FAT of the new product;
- TSOs wouldn´t have to implement a product which they would not use;
- FATs of 10 and 15 min are quite similar.

For this purpose, three options have been compared:

- **Option 1 - 15 min FAT**: all TSOs using a FAT < 15 min would change their FAT to 15 min;
- **Option 2 - FAT around 12,5 min**: all TSOs would change their FAT to a FAT around 12,5 min (exact FAT must be defined in the future). The reason why the FAT should not be greater than 13 min is that this FAT would, in any case, comply with TTRF even under consideration of a process time;
- **Option 3 - Different FATs - one XB exchange**: all TSOs could keep their FAT between 10 and 15 min but there would only be one shape of the cross border exchange with a ramp of 10 min. The reason for a ramp of 10 min is that by this in the case of a mFRR import the

TSOs with a FAT of 10 min would at least get the mFRR as fast as if they would have activate in their own Control Area.

The comparison is detailed below and could be further elaborated with a more detailed analysis:

Table 1 : Comparison of the different options to merge the two mFRR products with a 10 and 15 min FAT (for the sum it is assumed that there is an equal weight of all criteria)

Option / Criterion	Level playing field	Liquidity	Effort implementation	Certainty of fulfilling TTRF requirements given the two possible interpretations (1 or 2)	Shorter GCT	Reduce ACE (faster reaction BSPs and deviations to XB exchange)	sum
Option 1: 15 min FAT	1	1	0	0	-1	0	0,17
Option 2: FAT around 12.5 min	1	-1	-1	1	0	1	0,17
Option 3: Different FATs -one XB exchange	-1	0	1	1	-1	0	0,00

Explanation criteria

Level playing field: With this criterion it is evaluated if the FAT is the same in all Control Blocks.

Liquidity: With this criterion it is evaluated that liquidity will be reduced with decreasing FAT.

Effort implementation: With this criterion the effort for the implementation of the different options is evaluated. With this criterion it is evaluated as well that it is easier for TSOs to join the cooperation if they don´t have to change their FAT. The second survey showed, that 14 from 21 TSOs which answered have a FAT of 15 min. Therefore this option gets the score 0.

Fulfill TTRF requirements independent of interpretation 1 or 2: With this criterion it is evaluated if the option complies with TTRF independent of the interpretation of the TTRF requirement. E.g. a FAT of 10 min would comply with the TTRF requirements according to interpretation 1 and 2. As a reminder, the project EXPLORE has recently issued a question regarding the requirements the SOGL imposes on the necessary ramping speed (full activation time – FAT) of the mFRR product. Interpretation 1 or 2 refers to the two possible interpretations. They are also described in the standard products document (§5.2.1.3).

Shorter GCT: With this criterion it is evaluated that GCT can be reduced with decreasing FAT.

Reduce ACE (faster reaction BSPs and deviations to XB exchange): With this criterion it is evaluated that ACE can be reduced with a faster FAT and with a common FAT in all Control Blocks, since it is easier to define a shape of the cross border exchange reducing ACE if there is a common FAT.

On top of the discussions regarding the merge of a 15 minutes FAT product and a 10 minutes FAT product, the relatively small Nordic system needs would require a product that is even faster than 10 minutes (e.g. 5 minutes) to comply with the frequency quality standards and to handle grid constraints within and between bidding zones.

At this stage it was decided to remove the 5 minutes FAT product from the list of standard products as only a group of TSOs would be ready to implement it. This group of TSO might however expand in the future, as the need for faster products may increase related to shorter time resolution in markets, more fluctuating production and increased exchange of balancing products. This product could be reintroduced as a standard product during the review of standard products that should take place at least every two years.

Nevertheess there is a risk for the concerned TSOs to lose this flexibility in the future. They mainly fear the pressure put on limiting the use of specific products (cf. article 26 Requirements for specific products). Moreover, BSPs will get economic incentives by standardization of settlement rules to deliver slower than the current situation. Svenska Kraftnät and Statnett therefore advocate for a 5 min FAT product that would not be considered as any other specific product and that could be exchanged at a regional scale.

Proposal

At this stage, TSO agree on keeping only one mFRR product even if no FAT option is put forward by the TSOs. While the final choice is being made, the FAT of the mFRR product remains unknown: it lies somewhere between 10 minutes and 15 minutes as it has been agreed to remove the 5 minutes FAT product.

In addition to the mFRR product, some TSOs are convinced of the benefit of using a standard product with a FAT lasting more than 15 minutes (RR products). Therefore, to comply with these TSO needs and processes, ENTSO-E proposes one RR product with a FAT of 30 minutes.

Conclusion:

	mFRR product	RR product
Preparation period	From 0 to x minutes	From 0 to 30 minutes
Ramping period	From 0 to x minutes	From 0 to 30 minutes
Full activation time	**x minutes, x being between 10 and 15 minutes**	**30 minutes**

5.2.1.4 Point of activation

Background

FAT is the time between the point of activation up until the BSP is fully delivering.

Different options where discussed among TSOs and there was no clear preference for one of the options therefore it has to be further elaborated which option shall be used.

The point of activation is dependent on the shape of the cross border exchange and will be investigated for the case of a schedule activation.

There is at least one boundary condition: the ramping period is expected not to start after the beginning of the period where energy is requested by TSOs.

Another interesting aspect is when the last direct activation can be required. If e.g. the schedule activation algorithm needs 30 s and the direct activation algorithm needs 30 s too, then the last direct activation can be required 30 s before the start of the schedule activation algorithm respectively 1 min before the end of the schedule activation algorithm.

Procedure

The following options are foreseen as the possible point of activation in the case of schedule activation in relation to the beginning of an ISP. E.g. 5 min means that the point of activation is 5 min before the beginning of the ISP. Please note that full delivery always starts 5 minutes after the beginning of the ISP according to the cross border exchange.

Option 1: 5 min;
Option 2: 7,5 min before ISP;
Option 3: 10 min before ISP;
Option 4: 15 min before ISP.

In the case of a direct activation the distance between the point of activation and the start of the cross border exchange would be equal to the distance in the case of a schedule activation.

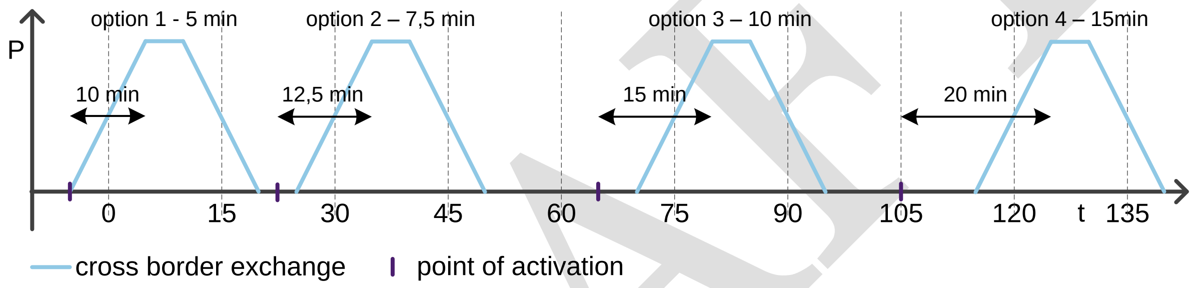

Figure 5: illustration of the options for the point of activation

Comparison of options

It must be underlined that the scores for the criteria depend on the FAT of the merged product. Therefore the scores could change after the decision is made.

Table 2: comparison of the different options for the point of activation for the merged mFRR product (for the sum it is assumed that there is an equal weight of all criteria)

option / criterion	Volume of energy delivered within main ISP (BSP ramping > 10 min)	fast delivery	Shorter GCT	Reduce ACE (deviation from cross border exchange for BSP ramping > 10 min)	reduce risks of counteractivations	available time for BSPs	sum
Option 1: 5 min	-1	1	1	-1	1	-1	0,00
Option 2: 7,5 min	1	0	0	1	0	0	0,33
Option 3: 10 min	1	-1	-1	1	-1	1	0,00
Option 4: 15 min	1	-2	-2	1	-2	2	-0,33

Explanation criteria

Volume of energy delivered within main ISP (BSP ramping > 10 min): It is evaluated how much energy a BSP with a ramping period > 10 min can deliver within the main ISP. In the case of a ramping period of 15 min a BSP can deliver less energy in the main ISP if the BSP is activated 5 min before the beginning of that ISP compared to an activation 7,5 min or even longer before the ISP.

Fast delivery: It is evaluated how fast a TSO will receive the requested power after activation especially in the case of an import of energy. E.g. in the case of option 5 min the importing TSO would get the full requested power 2.5 min earlier than in the case of option 7.5 min.

Shorter GCT: it is evaluated how close the GCT of the balancing energy market can be to the ISP.

Reduce ACE (deviation from cross border exchange for BSP ramping > 10 min): It is evaluated how big the difference between the shape of the cross border exchange and the real delivery can be in the case of a BSP with a ramping period greater than 10 min. If there is e.g. a BSP with a FAT of 12,5 min the deviations from the shape of the cross border exchange will be smaller in the case of option 7,5 min compared to 5 min.

Reduce risks of counteractivations: It is evaluated how big the risk of counteractivations is. The longer the distance between the point of activation and the beginning of the cross border exchange, the higher the risk.

Proposal

It is proposed to wait for the decision about the merged mFRR product before making a decision.

5.2.1.5 Minimum and maximum quantity

5.2.1.5.1 Minimum quantity

For the two manual products proposed the BSP should provide balancing energy bids of at least 1 MW. This is a result of consensus between TSOs, who want the minimum quantity to be big enough to carry out their work in good conditions, and BSPs, who want the minimum quantity to be small enough to facilitate their participation.

5.2.1.5.2 Maximum quantity

For the two manual products proposed the BSP should provide balancing energy bids of at most 9999 MW. That ceiling is mainly justified by IT reasons. If needed, TSOs could further define a maximum quantity for indivisible bids.

5.2.1.5.3 Divisibility

For the two manual products, even if TSOs are interested to activate only a part of one bid, BSPs are not always in the position to deliver a partial bid (e.g. a single generation unit is often able to be stopped or deliver nominal power, but nothing else: it could be in the absence of adequate regulation process or due to the machine itself). Therefore, in order to collect as much bids as possible and increase competition between BSPs, it should be allowed to submit non-divisible bids on all manual standard products.

5.2.1.5.4 Conclusion

	mFRR product	RR product
Preparation period	From 0 to x minutes	From 0 to 30 minutes
Ramping period	From 0 to x minutes	From 0 to 30 minutes
Full activation time	x minutes, x being between 10 and 15 minutes	30 minutes
Minimum quantity	**1 MW**	
Maximum quantity	**9999 MW**	
Divisibility	**Yes or No**	**Yes or No**

5.2.1.6 Deactivation period

For the two manual products, the duration of the deactivation period equals the full activation time.

5.2.1.7 Minimum and maximum duration of equivalent delivery period

At the beginning it was forseen to use minimum and maximum duration of delivery period. However, the delivery period depends on the tolerance band and TSOs propose that the tolerance band could be defined individually by each TSO (s. Figure 6 and article 5.2.1.11).

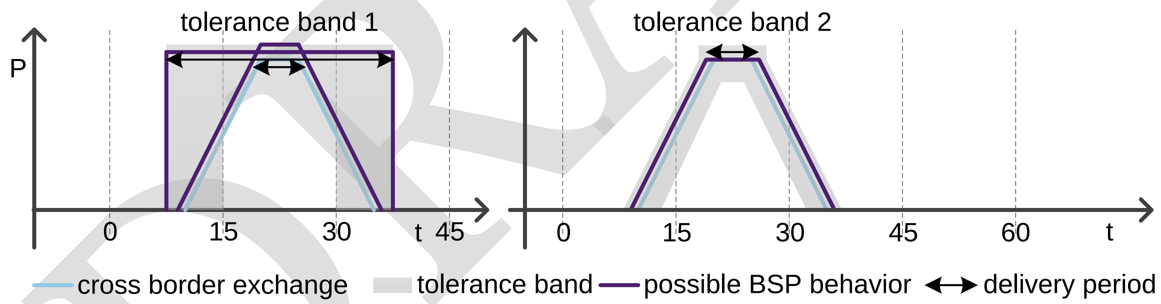

Figure 6: illustration of different tolerance bands and their influence on delivery period in the case of a schedule activation with a fixed shape of the cross border exchange of the merged mFRR product. Since the tolerance band can be defined by each TSO individually, it is not possible to define a global minimum and maximum delivery period.

By this it is proposed to use a characteristic which is based on the requested energy and the shape of the cross border exchange, since there are no tolerances in the case of the cross border exchange. This characteristic can be used in all cases even if the delivery of the balancing energy product does not lead to a cross-border exchange (when the need and the delivery of balancing energy take place in the same control area). Moreover it is proposed to make this characteristic independent of the ramps of the cross border exchange, since the ramps could change in the future. Therefore the exchanged energy should be considered for this characteristic and not the duration of activation since the duration depends on the ramps.

The proposal is to use the characteristic **equivalent delivery period**. It is defined as the energy which is requested by the TSO divided by the maximum power which is requested. Therefore it gives the length in time of the TSO's energy request.

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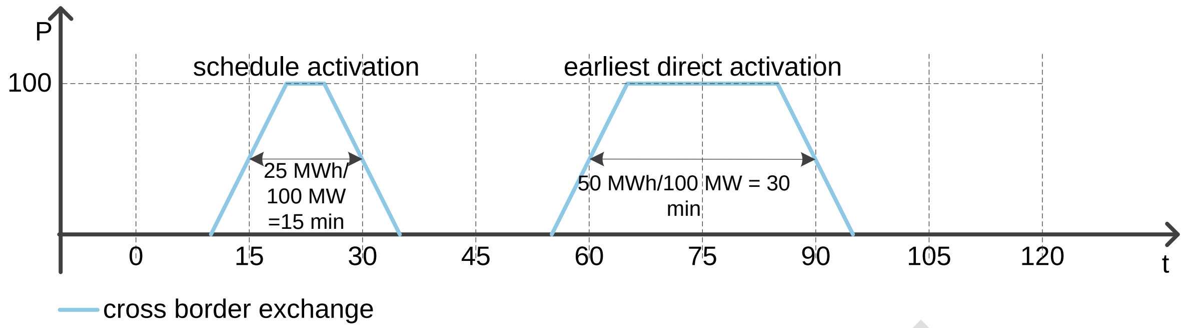

Figure 7: illustration of the equivalent delivery period for a schedule activation and the earliest direct activation of the merged mFRR product

In order to develop products which fit with the needs of a maximum number of TSO, three options were identified:

- define several products to cover different needs (e.g. one product with 15-30 minutes equivalent delivery period and one product with 30-45 minutes equivalent delivery period). This first option has the disadvantage to increase the number of products (not compliant with ACER request nor with development of a liquid European wide market), and is therefore not suitable for a European implementation;
- define only one product with a very wide range of equivalent delivery period (e.g. 0-45 minutes) to cover all TSOs needs. This option leads BSPs to offer very flexible bids which are not available everywhere in Europe (e.g. depending on energy mix). It is finally counterproductive and against developing liquid market. Moreover these products could be too flexible for some TSOs which do not require the full range of delivery. In such a case it will unduly increase local procurement costs and the balancing GCT would unnecessarily be far from real-time (potentially impacting local ID markets). This solution to cover all balancing needs seems not relevant as well;
- define only one product with a range of equivalent delivery period which covers the needs of a majority of TSOs. It will lead to define some specific products if needed and is the compromise found by ENTSO-E to define the minimum and maximum duration of equivalent delivery periods.

5.2.1.7.1 Minimum duration of equivalent delivery period

For the minimum duration of equivalent delivery period, the main driver has been the alleged ability of BSPs to provide the required flexibility and thus make sure that this value will not prevent us from developing a liquid European balancing market.

5.2.1.7.2 Maximum duration of equivalent delivery period

For the maximum duration of equivalent delivery period the main driver has been the requirement to avoid an overlap with intraday energy market. Thus the duration of balancing products has to be compliant with the minimum value of the intraday cross-zonal gate closure time (IDCZGCT). The combination of EBGL and the capacity allocation and congestion management guideline (CACM) gives the following requirement: the balancing energy gate closure time (BEGCT) shall not be before the IDCZGCT. At the moment the shortest IDCZGCT is 45 minutes. Therefore, if we stay with the current situation, the maximum duration of equivalent delivery period for products used across all Europe (meaning mFRR) should not exceed 45 minutes.

Regarding all standard products, ENTSO-E suggests that, by default, the equivalent delivery period always stops at the end of an ISP boundary.

5.2.1.7.3 Conclusion

	mFRR product	RR product
Preparation period	From 0 to x minutes	From 0 to 30 minutes
Ramping period	From 0 to x minutes	From 0 to 30 minutes
Full activation time	x minutes, x being between 10 and 15 minutes	30 minutes
Minimum quantity	1 MW	
Maximum quantity	9999 MW	
Divisibility	Yes or No	Yes or No
Minimum duration of equivalent delivery period	**15 minutes**	**15 minutes**
Maximum duration of equivalent delivery period	**30 minutes**	**15/60 minutes**

5.2.1.8 Activation principle

For the manual products proposed, ENTSO-E distinguishes two main types of activation principles: direct (DA) and scheduled (SCH) activations.

5.2.1.8.1 Direct activation

For a direct activated product, the activation request from the TSO can be issued at any point in time, while respecting the product requirements. Such a product can be activated and exchanged between TSO very close to real time (depending on technical characteristics of the product) because it does not need to be activated through a scheduling process.

DA is needed for the TSOs which are using mFRR to resolve the imbalances caused by the reference incident. In order to comply with the TTRF, they have to have the ability to activate mFRR bids at any time when a large imbalance occurs.

5.2.1.8.2 Scheduled activation

For a schedule activated product, the activation request from the TSO is issued at a specific point in time and the delivery is based on a scheduling time interval (or many scheduling time intervals until it does not interfere with the cross zonal intraday market as defined in paragraph 5.2.1.7), currently defined in Europe to 1 hour or 15 minutes depending on TSO and borders.

SCH activation is typically used to replace previously activated aFRR or mFRR. For the TSOs, it allows developing a netting process to prevent activation of balancing energy bids in opposite direction, subjected to the available cross-border capacities. For the BSPs, it allows having a defined timing for the activation, which would be useful when the capacity is offered subsequently in different markets (for instance: used in ID and then offered as mFRR).

5.2.1.8.3 Combined direct and scheduled activation

In order to reduce the number of standard products and obtain additional market liquidity, ENTSO-E has investigated the merging of the DA and SCH 15 minutes FAT products into one product (or the combination of two products in one CMOL).

A combination of DA and SCH activations in one CMOL has the following **advantages**:

- **Prevents fragmentation of markets and therefore increases liquidity in remaining markets**: BSPs do not have to choose between different CMOLs and with a single BEGCT, the same bid can be used for both needs;
- **Reduces number of standard products:** in line with target for streamlining standard products and in accordance with feedback from ACER;
- **Enables cooperation between TSOs either using mainly direct or mainly schedule activated products.**

One **disadvantage** of combining direct and scheduled activation might be that depending on the pricing method, the prices for two different products with different requirements are linked. By this the price for schedule activation might be too high for example. One solution to overcome this problem might be to have two different prices, one for schedule activation and one for direct activation. This is further detailed in the settlement part.

One of the key challenges is to develop a methodology for combining direct and scheduled activated products in 1 CMOL.

It is assumed here that there is only one product, for which it is possible to do a DA or a SCH activation. By this assumption, an optimisation between two CMOLs is avoided and the same gate closure time can be used. Different prices for DA and SCH activation could be applied if such a mechanism was required to differentiate the price of DA and SCH (see Section 6.1).

Given that in this circumstance there is only one product with bids in one CMOL, two high-level options are available regarding the order in which the two activation principles (DA and SCH) acess the bids:

- Option 1: DA is activated first with SCH activation possible afterwards using remaining bids;

- Option 2: SCH is activated first with DA activation possible afterwards using remaining bids.

The first questions discussed within ENTSO-E are as follows:

Question 1: What order of activation provides the highest fulfillment of TSO needs and increases social welfare?

We investigate and describe further these two options for combining schedule and direct activation in order to understand the potential advantages and disadvantages of each solution. It should be noted that many variations of these two options are possible, particularly with regard to varying the minimum and maximum delivery periods in each scenario. This initial assessment therefore will not decide on the definitive solution for merging the SCH and DA 15 minute products. Instead we will consider different advantages and disadvantages of the two concepts and highlight if any solutions can be ruled out. Further work will then be done to develop the most advantageous concepts.

One consideration which potentially will impact the preferred order of activation is the interaction of each CMOL with multiple ISPs. It is therefore preferred at this stage to also consider for the two activation options if the energy is mainly delivered in the same ISP as the one which the CMOL refers to, and also when this is not the case.

Question 2: How does the order of activation affect the number of ISPs over which a CMOL is valid? The comparison between the two options is detailed in the appendices (7.2).

5.2.1.8.3.1 Conclusion

	mFRR product	RR product
Preparation period	From 0 to x minutes	From 0 to 30 minutes
Ramping period	From 0 to x minutes	From 0 to 30 minutes
Full activation time	x minutes, x being between 10 and 15 minutes	30 minutes
Minimum quantity	1 MW	
Maximum quantity	9999 MW	
Divisibility	Yes or No	Yes or No
Minimum duration of equivalent delivery period	15 minutes	15 minutes
Maximum duration of equivalent delivery period	30 minutes	15/60 minutes
Activation principle	**DA/SCH**	**SCH**

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5.2.1.9 Links between bids

As mentionned in article 5.1.2.5, links between bids allow BSPs to offer more flexibility and maximise the opportunity to be activated by fitting with TSO needs. At the same time, it generates complexity for the algorithm of the activation optimization function.

The possibility to authorize links between bids has been validated for RR product and should be studied more precisely for products mFRR in the implementation phase.

Conclusion:

	mFRR product	RR product
Preparation period	From 0 to x minutes	From 0 to 30 minutes
Ramping period	From 0 to x minutes	From 0 to 30 minutes
Full activation time	x minutes, x being between 10 and 15 minutes	30 minutes
Minimum quantity	1 MW	
Maximum quantity	9999 MW	
Divisibility	Yes or No	Yes or No
Minimum duration of equivalent delivery period	15 minutes	15 minutes
Maximum duration of equivalent delivery period	30 minutes	15/60 minutes
Activation principle	DA/SCH	SCH
Links between bids	**?**	**Yes**

5.2.1.10 Latest draft set of manual standard products

The above detailed elements lead to the following set of manual standard products:	mFRR product	RR product
Preparation period	From 0 to x minutes	From 0 to 30 minutes
Ramping period	From 0 to x minutes	From 0 to 30 minutes
Full activation time	x minutes, x being between 10 and 15 minutes	30 minutes

Minimum quantity	1 MW	
Maximum quantity	9999 MW	
Divisibility	Yes or No	Yes or No
Minimum duration of equivalent delivery period	15 minutes	15 minutes
Maximum duration of equivalent delivery period	30 minutes	15/60 minutes
Activation principle	DA/SCH	SCH
Links between bids	**?**	**Yes**

5.2.1.11 Behaviour expected from BSPs

A perfect delivery would equal the shape of the cross-border exchange which is detailed in chapter 6.3.1. Out of technical reasons a perfect delivery is not possible. Therefore a tolerance band should be used defining the acceptable behavior of BSPs.

There is no need for a global tolerance band which is applied by all TSOs since it is up to the respective TSO to define a tolerance band according to its needs. Nevertheless tolerance bands should not differ that much in order to keep a level playing field between BSPs.

The implementation of a tolerance band may require a monitoring system, in order to check that the requirements set by the tolerance band are fullfilled. By this a TSO could define a very strict tolerance band, but if there is no monitoring, then this tolerance band is almost useless. In any case it is up to the respective TSO to define apart from the tolerance band, any monitoring system and/or incentives.

For both products the tolerance band is drawn together with the cross-border exchange. The shape of the cross-border exchange can be considered as the perfect delivery.

The tolerance band should be aligned with the incentives given by the BSP settlement and the BRP adjustment.

The definition of the tolerance band can have an influence on preparation period and ramping period.

5.2.1.11.1 mFRR product

Background

The tolerance band depends on the decision about the merged product. If e.g. a FAT of 15 min is chosen than the tolerance band is wider than in the case of a FAT of 13 or 10 min.

Procedure

Figure 8 and Figure 9 show different possible tolerance bands for the merged mFRR product.

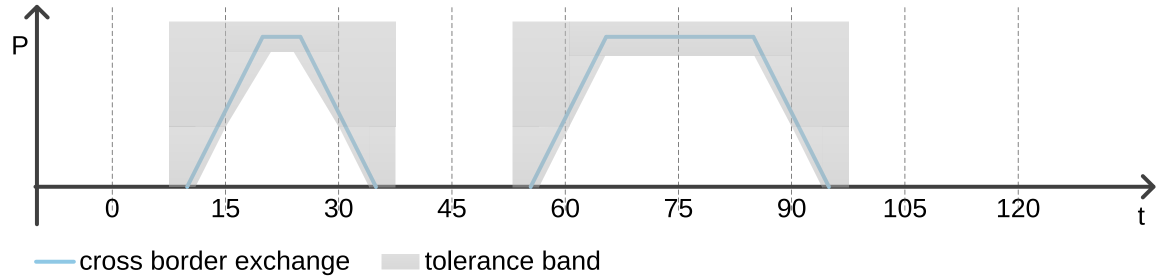

Figure 8: illustration of a possible tolerance band for the merged mFRR product (under the assumption that a FAT of 15 min is allowed)

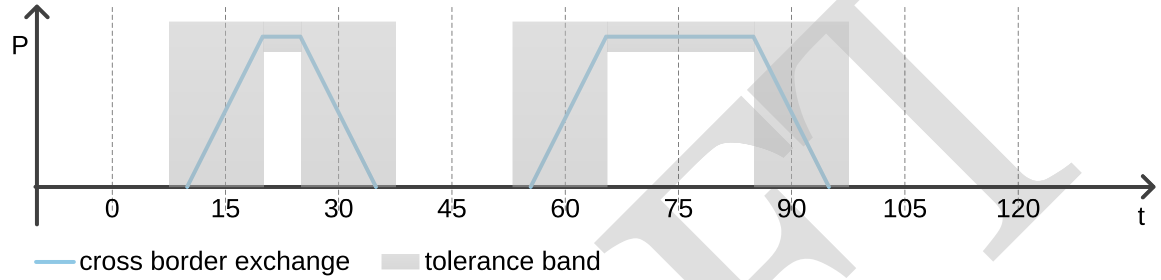

Figure 9: illustration of another possible tolerance band for the merged mFRR product (under the assumption that a FAT of 15 min is allowed)

Proposal

It is up to the respective TSO to define a tolerance band, therefore no proposal for a global tolerance band is given.

5.2.1.11.2 RR product

Background

The TERRE members will discuss the tolerance band in November.

Procedure

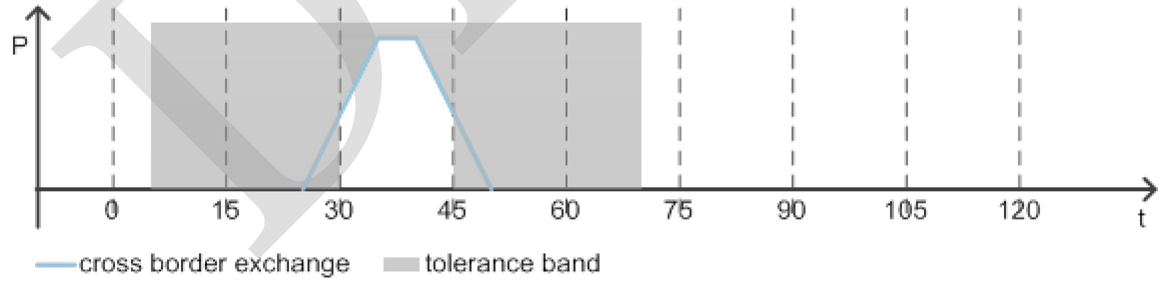

Figure 10 : illustration of a possible tolerance band for the RR product

Proposal

It is up to the respective TSO to define a tolerance band, therefore no proposal for a global tolerance band is given.

5.2.2 Automatic standard products

5.2.2.1 General characteristics

The EBGL promotes the exchange of harmonized aFRR products at a European level. Ideally, the aim in the product development process should be to achieve this target from the beginning. Yet system complexity and significant differences across and within synchronous areas together with time constrains for implementation indicate that aiming at one product for the European level may be too ambitious at this stage.

This perception is shared by a large majority of the TSOs. Striving for one product per synchronous area is a trade-off between liquidity and specific aFRR needs of each synchronous area. Nevertheless, it can be expected that the natural evolution of the market will allow for merging the synchronous area products into one European aFRR product at a later stage.

5.2.2.2 Full activation time

As mentioned above (5.2.1.3), the full activation time for the aFRR product has to be fast enough to respect TTRF. Given that constraint, and the existing values of FAT around Europe, a limited number of scenarios were listed for the FAT: 2.5, 5, 7.5, 10 and 15.

Based on this observation, the TSOs survey results led to the following options being left for the full activation time.

	RGCE	RG Nordic	RG Baltic	RG UK	RG Ireland
Preparation period	<= 30 s (SOGL : aFRR providing unit of FRR providing group for automatic FRR shall have an automatic FRR activation delay of at most 30 seconds)				
Ramping period	Not relevant				
Full activation time	5 minutes or 7.5 minutes	5 minutes	?	5 minutes	5 minutes
Minimum quantity	1 MW				
Maximum quantity	9999 MW				

5.2.2.3 Validity period

Contrary to manual standard products, it seems to be more important to define the validity period than minimum and maximum duration of the delivery period. In fact, the delivery period is not a relevant characteristic of an automatic product, given the behavior of the automatic controller.

Currently, TSOs use validity periods ranging from one year to 15 minutes. Although longer validity periods may reduce operational risks, they allow less flexibility for BSPs whose capacity is highly dependant on rapidly changing external factors (weather, spot prices). An overlapping with ID-Markets should be kept in mind as well. Shorter validity periods on the other hand may increase liquidity and market efficiency, allowing for more flexibility and the participation of units with limited storage. Still, a short validity period could be more complex to implement.

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Over 80% of the TSOs would be in favour of a validity period shorter than four hours and almost half of the TSOs prefer a validity period of one hour. Therefore, further analysis should be focused on the following validity periods: 4 hours, 1 hour and 15 minutes.

	RGCE	RG Nordic	RG Baltic	RG UK	RG Ireland
Preparation period	<= 30 s (SOGL : aFRR providing unit of FRR providing group for automatic FRR shall have an automatic FRR activation delay of at most 30 seconds)				
Ramping period	Not relevant				
Full activation time	5 minutes or 7.5 minutes	5 minutes	Not applicable	? (5 minutes)	? (5 minutes)
Minimum quantity	1 MW				
Maximum quantity	9999 MW				
Minimum duration of delivery period	Not relevant				
Maximum duration of delivery period	Not relevant				
Validity period	15 minutes or 1 hour or 4 hours	1 hour	Not applicable	? (1 hour)	? (4 hours)

5.2.2.4 Divisibility of the bid

Management of the system balance with automatic FRR usually leads to partially activate the bids in order to solve the imbalance with the highest possible accuracy as possible. The consequence is automatic activated bids (i.e. aFRR) should be divisible. It is requested by the TSO and it is necessary if a BSP wants to offer aFRR product. Such a requirement should not raise concerns from BSP side due to the behaviour of installed load frequency controller's regulations.

5.2.2.5 Control signal

5.2.2.5.1 General principles

For the automatic product proposed, ENTSO-E distinguishes at least two main types of control signals:

Respecting the FAT – "***aFRR FAT product***"

- The control signal to BSPs is based directly on the TSO need and not limited by the ramp rate;
- BSPs are expected to deliver the full power requested by the TSO at latest after a delay equal to FAT;
- Limited requirements on preparation period or ramp rate.

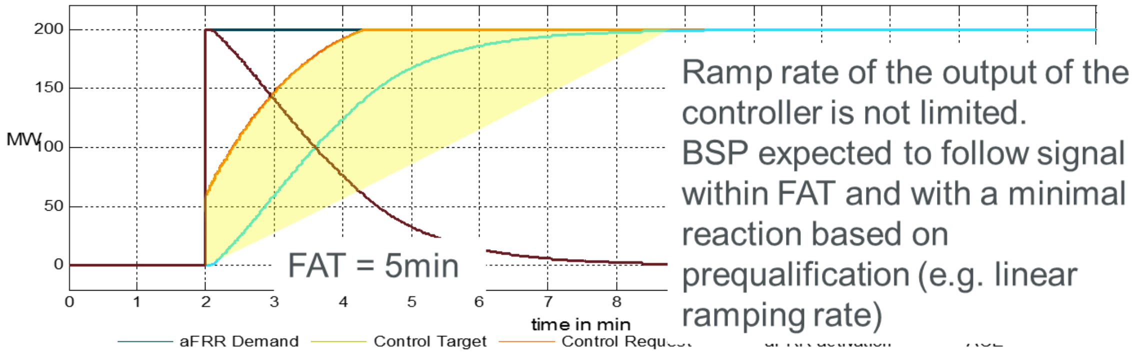

Figure 11 : aFRR FAT product

Following the setpoint – "***aFRR setpoint product***"

- The control signal to BSPs is a setpoint that takes into account the (fixed) BSP ramp rate;
- BSPs are expected to follow the signal sent by the TSO.

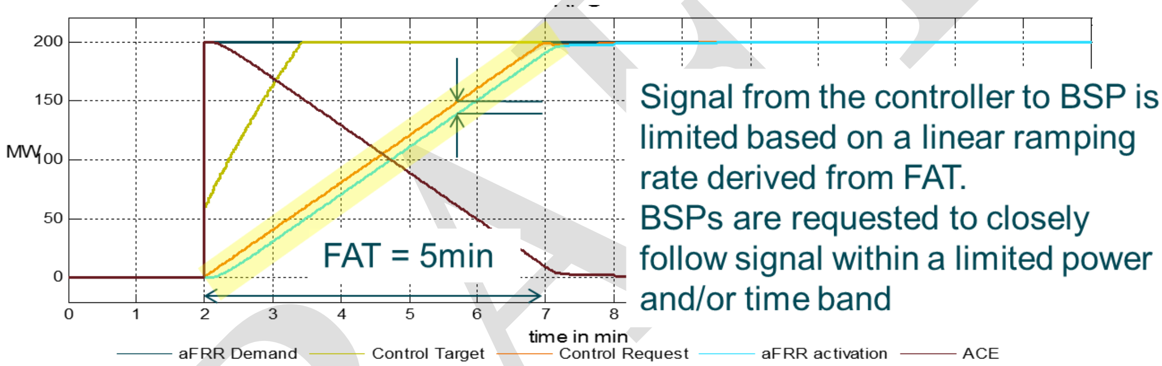

Figure 12 : aFRR setpoint product

5.2.2.5.2 Comparison between the two options

aFRR FAT product	aFRR setpoint product
+ Low prequalification requirements	+Activation equals alsmot requested signal
+ High flexibility for BSP	+Requested value can be used for settlement
+On average higher speed than prequalified FAT (in case incentivized, experience DE/AT)	-Ramp limitation needed
+No ramp limitation needed	-/+ (?) Higher prequalification requirements needed (might lead to lower liquidity)
-Measurement for settlement favorable	

At this stage, no final choice has been made on the control signal.

5.2.2.6 Activation principle

5.2.2.6.1 Merit order activation

Currently a majority of countries in Europe use pro-rata activation, which has proven to deliver high quality results in terms of restoring and maintaining the system frequency. There is concern that by moving to the merit order activation speed will decrease and geographic distribution will be limited which both may affect the frequency quality negatively.

Therefore, the final design could slightly deviate from pure merit order activation.

At this stage, no final choice has been made on the exact set up of the merit order activation.

5.2.2.6.2 Control concept for cross border exchange

For the automatic products proposed, ENTSO-E distinguishes three main types of cross border exchange principles: control demand, control request and control target.

This is further detailed in chapter 6.3.1.2.

5.2.2.7 Links between bids

As mentionned in Section 5.1.2.5, links between bids allow BSPs to offer more flexibility and maximise the opportunity to be activated by fitting with TSO needs. At the same time, it generates complexity for the algorithm of the activation optimization function.

ENTSO-E considers that the links between bids should not be allowed for aFRR bid. Indeed, as explained in the paragraph 5.1.2.5 the link between bids allow the management of power limits and energy constraints, while the aFRR consists of bids which should be divisible (no power constraint) and could be activated for longer duration (e.g. up to some hours a day depending on the validity period).

6. BEYOND MANUAL STANDARD PRODUCTS

6.1 Pricing of balancing energy

6.1.1 Targets

EBGL requires that a proposal for harmonised pricing method for balancing energy based on « marginal pricing » should be developped one year after entry into force of the code (article 47).

The harmonised pricing method shall:

(a) *be based on marginal pricing (pay-as-cleared);*

(b) *establish at least one price of balancing energy for each imbalance settlement period ;*

(c) *give correct price signals and incentives to market participants ;*

(b) *take into account the pricing method in the day-ahead and intraday timeframes.*

Moreover, EBGL gives the following recommandations:

- balancing energy prices shall **<u>not be capped or floored</u>** ;
- the harmonised pricing method shall be used for **<u>all standard products</u>** and specific products converted to « standard products » ;
- for specific products the concerned TSO may propose a different pricing method.

6.1.2 Description of the different pricing methods

According to EBGL recommandations, several pricing methods were discussed and analysed between TSOs, which combine different features such as:

- (a) marginal pricing or pay-as-bid ;
- (b) local pricing or cross-zonal-pricing ;
- (c) « per product and per mode of activation », « per product », or « cross-product ».

6.1.2.1 Marginal or pay-as-bid pricing, local or cross-zonal pricing

6.1.2.1.1 Options description

In the following articles the different pricing methods combining (a) and (b) features are described. For the explanation of the financial flows it is assumed that positive balancing energy with a positive price is activated. It is also assumed that there is no other balancing energy activated for the calculation of the imbalance settlement price.

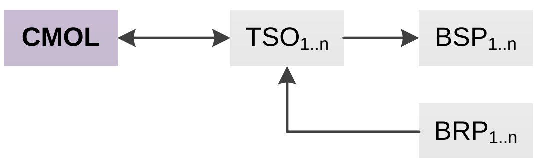

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Figure 13: illustration of the financial flows and the relevant parties

Cross Zonal Marginal pricing – congestion rent (XZMP-CR)

TSO --> BSP	The most expensive bid activated in a non-congested area determines the price within all Control Blocks in this non-congested Area. Every BSP gets this price multiplied with the balancing energy delivered by the BSP from its connecting TSO.
TSO <--> CMOL	The TSO has to pay the marginal price in its Control Block multiplied by the balancing energy which it requested. The TSO gets the marginal price in its Control Block multiplied with the balancing energy which was activated in its area. If there is congestion in the platform, the CMOL makes a "benefit" (congestion rent is collected). Congestion rent being generated on congested borders; it is distributed to the TSOs of each border (according to a rule define with the input from the NRAs and if possible equivalent to the ATC market coupling standard congestion rent distribution arrangements).

Marginal pricing – one local price for all BSPs (MP-LPfaB)

TSO --> BSP	The most expensive bid activated within a Control Block determines the price within this Control Block. Every BSP gets this price multiplied with the balancing energy delivered by the BSP from its connecting TSO.
TSO <--> CMOL	TSO exporting balancing energy: The TSO gets the marginal price in its Control Block multiplied with the balancing energy which was activated in its Control Block. TSO importing balancing energy: The TSO pays the average marginal price of all exporting TSOs multiplied with the balancing energy which was imported by this TSO. No congestion rent is generated.

Marginal pricing – different local prices for BSPs (MP-dLP)

TSO --> BSP	Importing TSO: all BSPs in the Control Block of the importing TSO which have been activated get the same price. Exporting TSO: The cheapest BSPs in the Control Block which were activated because of the need of the exporting TSO get the same price, which is the price set by the most expensive BSP, which was needed to cover the needs of the exporting TSO. BSPs which were activated for exporting balancing energy get their pay-as-bid price.
TSO <--> CMOL	Importing TSO: they pay the pay-as-bid price of the exporting BSPs. Exporting TSO: They get the pay-as-bid price of the exporting BSPs.

Pay-as-bid – congestion rent (PaB-CR)

TSO --> BSP	Every BSP gets its bid price multiplied with the delivered balancing energy of this BSP from its connecting TSO.
TSO <--> CMOL	Exporting TSO: The exporting TSO gets the difference between its real costs for the BSP payment and the costs which the TSO would have had based on its own need and the average weighted price of all activated BSPs within the non-congested area in which the Control Block of the TSO is located. Importing TSO: The importing TSO pays the difference between the costs which the TSO would have had based on its own need and the average weighted price of all activated BSPs within the non-congested area in which the Control Block of the TSO is located and its real costs for the BSP payment. If there are congestions in the platforem, the CMOL makes a "benefit" (congestion rent is collected). Congestion rent distribution could be designed to be as close to the 50/50 arrangement used for ATC market coupling.

Pay-as-bid –local pricing (PaB-LP)

TSO --> BSP	Every BSP gets its bid price multiplied with the delivered balancing energy of this BSP from its connecting TSO
TSO <--> CMOL	All exporting TSOs only cover the costs of their cheapest bids. All importing TSOs pay for the more expensive bids, which were exported, with an average of all exported bids. No congestion rent is generated

6.1.2.1.2 Criteria and analysis

The different settlement options are assessed based on the following qualitative criteria:

- Compliance with EBGL regarding marginal pricing, or will a derogation be needed?
- Interest to join the platform for each country: can the settlement rule guarantee that a country has always interest to join (BSP profit + Reduction of the balancing cost + TSO profit (congestion rent));
- Is cooperation profit shared in a "fair" way? This criteria is quite subjective. For the analysis it is assumed that if cooperation generated profit goes almost exclusively to the importing countries, the profit sharing may be consider as "unfair";
- Is congestion rent generated in case of congestion?
- In absence of congestion, are BSPs in different control blocks paid the same price (non discrimination)?

The following table provides a qualitative analysis of the possible options on the predefined criteria:

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Table 3 : Qualitative analysis of the different settlement options

	XZMP-CR	MP-dLP	MP-LPfaB	PaB-CR	PaB-LP
NCEB compliance, marginal pricing	↑	↑	↑	→	→
Non discrimation between BSP in one Control Block	↑	↓	↑	↑	↑
Non discrimation between BSP in different Control Blocks in absence of congestion	↑	↓	↓	↑	↑
Interest to join the platform for each country	↑	↑	↑	↓	↑
"Fair" profit sharing between countries	↑	→	→	→	→
Congestion rent generated in case of congestion	↑	↓	↓	↑	↓

6.1.2.2 "Cross-product", "per product" or "Per product and mode of activation"

6.1.2.2.1 Options description

In the following sections the different pricing methods combining (c) feature defined in article 6.1.2.1 are described.

Cross product pricing (XP – Pricing)

Cross product pricing means that there is the same price for settlement of aFRR, mFRR and RR balancing energy activated bids, which is calculated through a combination of the price given per product (per CMOL). As examples we could define a "balancing energy price" equal to the the:

- Average price of aFRR, mFRR, RR prices weighted per volume of energy activated per product;
- Marginal price of aFRR, mFRR and RR prices, ...

Per product pricing (PP- Pricing)

Per product pricing means that there is one price per product calculated through a given pricing method. As a consequence, the price of aFRR activated balancing energy could be different from the price of mFRR or even RR activated balancing energy.

Per product and per mode of activation pricing (PP&MA- Pricing)

Per product and per mode of activation pricing means there is one price for directly activated bids of one product and one price for scheduled activated bids of one product in case of the product is a combination of "two" modes of activation. This methodology only applies for mFRR products as RR product is only scheduled and aFRR is per definition directly activated.

6.1.2.2.2 Criteria and analysis

The different settlement options are assessed based on the following qualitative criteria:

- Compliance with EBGL regarding number of balancing energy prices ;
- Incentive for BSPs to be flexible ;
- Incentive for TSOs to use "scheduled" processes when DA is not necessary as they allow "netting" and should be cheaper;
- Complexity.

The following table provides a qualitative analysis of the possible options on the predefined criteria:

	XP - Pricing	PP-Pricing	PP & MA - Pricing
Compliance with EBGL	+++	+++	+++
Incentive for BSPs to be flexible	-	++	+++
Incentive for TSO to use "scheduled" processes	-	+	++
Complexity	+++	++	-

6.1.3 Proposal for a pricing method

TSOs propose to use the **cross zonal marginal price with congestion rent (XZMP – CR)** settlement option for RR and mFRR products. This settlement is the one currently used for market coupling. Where borders within a CMOL become congested, there would be different marginal prices at both sides of the border. According to 6.1.2.1, each of theses prices will be established based on the activated energy in a non-congested area. Due to the difference between the prices of the two countries at both sides of the border, a congestion rent is generated and will be redistributed between the two congested areas.

It is necessary to underline that the proposal is limited to "manually activated products" (RR and mFRR products) and does not prejudge settlement of aFRR, as the product and the market are by nature different.

TSOs do not want to apply « XP Pricing » because aFRR, mFRR and RR are different products with different requirement and therefore should be priced separately.

TSO agree on using a « PP-Pricing » in the following condition: DA bids should at least get what they would have got if they were scheduled activated. It implies that a TSO submitting a DA need just before or after SCH gate closure, cannot get « cheaper » balancing energy (see article 7.2).

6.2 Interactions with Algorithmic Design

6.2.1 Algorithm objectives

The purpose of an algorithm for Electricity Balancing is to select the combination of standard products that best fits the balancing needs of TSOs and aids them to maintain system balance. In this case, the objective is to maximise social welfare. If a price is put on TSO needs a least-cost objective function will deliver maximum social welfare.

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Although not covered elsewhere in this document, the algorithmic proposal for TERRE requires TSOs to both state what their needs are for a specific product, and to price that need. This approach is consistent with delivery of the maximum welfare / minimum cost objective.

6.2.2 Algorithm techniques

The use of security-constrained cost-minimisation algorithms is widespread in the electricity industry, particularly mature in American ISO markets where a class of tool known as a “Market Management System” has been developed. All such modern systems are based around optimisation using a Mixed Integer Linear Program (MIP). These define mathematical formulations of the business problem which are solved using an optimisation engine such as CPLEX or Gurobi. The formulation includes the needs, the available products, and constraints on the use of those products that satisfy both BSP and TSO.

As discussed – faster services can be used to meet slower targets, but the current approach for the European solution does not support this, at an impact on social welfare.

Clearly, algorithms of this type apply primarily to ‘Scheduled’ products. ‘Directly-activated’ products are traditionally identified in a simpler manner by picking from a price stack, with little possibility of optimisation because a directy activation presupposes the outcome of the request.

6.2.3 Likely impact of products on algorithm behaviour

6.2.3.1 Co-optimisation

The control of power systems is a continuum: frequency must be maintained at all times and in all planned circumstances. There must be a suite of products that allows this degree of system control to be achived with an acceptable margin of error. The best way of achieving this in a proactive control is to consider the effect of all decisions and needs as a whole, i.e. place all decisions into a single algorithm and let it determine the best overall solution by co-optimisation.

The proposals for algorithms to manage standard products do not do this, though. Instead they propose to consider individual aspects separately.

Breaking an integral problem into discrete parts will always reduce the optimality that can be achieved: the separation between times and between products effectively introduces binding constraints that prevents the algorithm from addressing wider issues. This problem becomes more fragmented by the certainty of the need to maintain national systems, and the growing use of localised systems at distribution level.

Algorithms can also undertake more complex analysis than simply procuring set volumes of individual products. Given the reducing inertia of power systems, system risks can be significantly affected by the product volumes chosen. Complex optimisation can consider adjustment of the risk according to system conditions by incorporating calculation of needs into the optimiser (increase inertia, increase response, deceas risk). Another aspect that the true purpose of the algorithm is to maintain TSO balance: this may be better done if the needs are expressed on a power system basis and not just on a product basis: this approach then allows the optimiser to use all the available products - for instance, faster products can be used to meet slower needs if this is the economic solution. The current approach for the European solution does not support this, at an impact on social welfare.

Actually, the idea is to adopt a pragmatic approach in the first place.

6.2.3.2 Complex product shapes

The products contain a number of integer (either/or) constraints: indivisible bids and linked bids. The magnitude to which integer constraints affect the output of a MIP affects the optimality that can be achieved. The “MIP gap” convergence criterion represents the greatest difference between the best ‘relaxed’ (linear) problem and the best integer solution. The greater the blockiness of the problem, the greater the best-achievable MIP gap will be. If the MIP gap is set unachievably low, no solution will be found by the algorithm, and lower gaps will extend run times. From an algorithmic viewpoint, therefore, excess use of these integer restrictions should be discouraged.

6.2.3.3 Spatial accuracy

A general requirement for a well-functioning market is that it delivers, and reacts rationally to, temporal and spatial (locational) price signals.

The prototype proposals for managing the RR and mFRR products deliver only a limited spatial signal, modelling only down to a control zones: in order to ensure that national issues are addressed TSOs are required to inform central algorithms which offers are ‘withheld’ because of national security constraints so cannot be used in the central optimisation. Therefore the central algorithm is unaware of the majority of spatial detail.

The EU codes bring products as low as 1 MW into the remit of central algorithms, which implicitly requires TSOs additionally to represent spatial restrictions on demand-side products arising from Distribution System Operator needs and restrictions. The key consideration is therefore the impact on TSO and DSO algorithms and in terms of complexity and problem size.

Central system effectiveness increases as further spatial detail is represeneted.

6.2.3.4 Temporal accuracy

Temporal signals are only partially represented in the prototype proposals: full co-optimisation requires awareness of the consequences of decisions, but the proposals separate the problem into one-hour timeslices and also propose to solve each product independently.

Within that hour there are links between the products, and also limits on the changes that can be made on interconnector flows within that period. However, without links between products and over time there is a significant likelihood of “greedy” optimisation where a particular resource is prematurely wholly consumed for a lower-value purpose (e.g. trading interconnectors wholly for energy when their reserve for FRR or FC is of higher value).

In addition, there is a rising volume of storage services (e.g. demand shifting, battery, flywheel) where delivering a product in one time potentially has a negative effect at a later time. The opening of RR provision to suppliers as low as 1MW will increase the volume of such services. The requirement for assessing these impacts lies with each product-suppliers systems, and is hidden from the central system. This places limitations on the ability of central systems to perform effective ‘proactive’ control and risks inefficient use of products.

Central system effectiveness would enhanced by having early provisional data for products so that a longer view could be taken.

6.2.3.5 Algorithm timing and performance

A critical consideration of a real-time control system is that there must be time to perform all the necessary calculations within the entire control sequence. For the standard products to be considered by a central system, consideration therefore must be made for the processing to be performed (a) by the product supplier, DSO and TSO systems before submitting data to the EU system; (b) the processing performed by the central system and (c) the processing to be performed after the results are provided to the TSO system.

The nature of the proposed solutions for managing the products forces some processing into the period before the central algorithm, such as derivation of TSO needs and withheld bids, and some of the processing after the central algorithm runs such as validation of national security and residual system balance once the standard products have been instructed. For the latter, this places a practical limit to the minimum lead time for standard products: TSOs operating proactive control using their own balancing algorithm will require longer notice than TSOs using reactive control based solely on regulating products. Similarly, product providers' systems must have time to create bids before the next hour, allowing for the impacts on their output of the central system's optimisation.

Another consideration is that during the period between data being submitted and results notified, the situation may have changed: the TSO network state may change invalidating the set of withheld bids, BSPs may fail making it impossible to deliver the bid, or BSPs may have adjusted their market position via intra-day trading: the product timeline means that some of the periods for which bids are submitted are outside market gate. Also, BSPs may reject the central algorithm instructions. Algorithm outputs may need to be verified as deliverable prior to instruction. This can never be eliminated unless algorithm run time is effectively instantaneous.

6.2.4 Relationship between central and national systems

As well as the issues discussed in the 'timing' section for national systems to feed into, and response to the outputs of central systems, there are wider issues about the innate compatibility of national systems with standard products.

Because all existing national systems have been constructed independently to represent the national balancing process (which differ considerably between TSOs), a new central algorithm of necessity is restricted to what details it can consider – it must be compatible with all existing national systems. Problem complexity and processing limitations are likely to require separate DSO, TSO and EU systems for the foreseeable future. Therefore a successful central algorithm must address the hierarchical relationship of these systems.

The practical nature of the need to ensure reliable control systems at a national level is likely to limit what can be ceded to a central system: it must be possible for national balancing to continue when the central system is unavailable.

However, it is possible to envisage a federated set of local, national and central systems that are all separate instances of the same algorithm, differentiated solely by data and options that determine which decisions each system takes and which it passes on to a more central system. Such an approach may be desirable as a long term goal but is wholly out of the scope for present work.

From a power-system perspective, such risks are the reason why reserves are held, and reserves will be activated accordingly. The ideal algorithm would be aware of when such faults have occurred, and would factor in the activation of such reserves into the next optimisation run.

6.2.5 Scalability of algorithmic solution

As noted in the introduction, the proposals here for standard products are the first step into creating an EU-wide balancing market. The set of products is therefore expected to be scalable towards their use in the full EU context, which will be true as long as the products are of use for all national balancing processes. This is not the case with an algorithm: a simplified algorithm is unlikely to be scalable because problem complexity rises steeply as the coupling between separate parts of the problem is introduced. Therefore, an EU-wide solution covering all products will require a far more complex and wide-ranging algorithm than one that treats products and times in isolation.

Also, for consistent behaviour a harmonised set of products needs to exist within a harmonised set of processes (and indeed, possibly, transmission system designs). As this process of wider harmonisation is not presently being considered, the end position for algorithms is presently unknown.

In order to perform a full solution to the problem, considering all products and a wider range of times, it might be the case that eventually only one central system will be needed. The development of the present set of prototype solutions therefore needs to consider their future evolution.

6.3 Cross-border exchanges

The activation model of balancing energy bids from the CMOL is essentially done following a TSO-TSO model, despite the guidelines allows another model called TSO-BSP model (article 35).

One consequence of a TSO-TSO activation model is that settlement of activated bids should also be based on this model. Therefore:

- a physical transaction (named « TSO-TSO cross-border physical exchange ») between TSO_A and TSO B will occur for the exchange of balancing energy ;
- a financial flow (named « TSO-TSO financial settlement ») associated to this transaction will also be settled between involved TSOs.

6.3.1 TSO-TSO cross-border physical exchange

6.3.1.1 Manual standard products

6.3.1.1.1 Shape of the cross-border exchange

TSOs make a difference between two approaches for cross-border physical exchange of products between TSOs:

- **Trapezoidal product**: the shape of the product is characterized by values of finite ramps either when starting (ramp-up) or stopping (ramp-down). The duration of ramping period for exchanging "balancing energy" between TSOs could be either equivalent to :
    - o the ramping period used for cross-border physical exchange of "energy" between TSOs (ie : 10 min, as set in all LFC controllers) ;
    - o a pre-defined value according to TSO needs and BSPs capabilities different from the ramping period used for cross-border physical exchange of "energy" ;
    - o a pre-defined value per type of technology.

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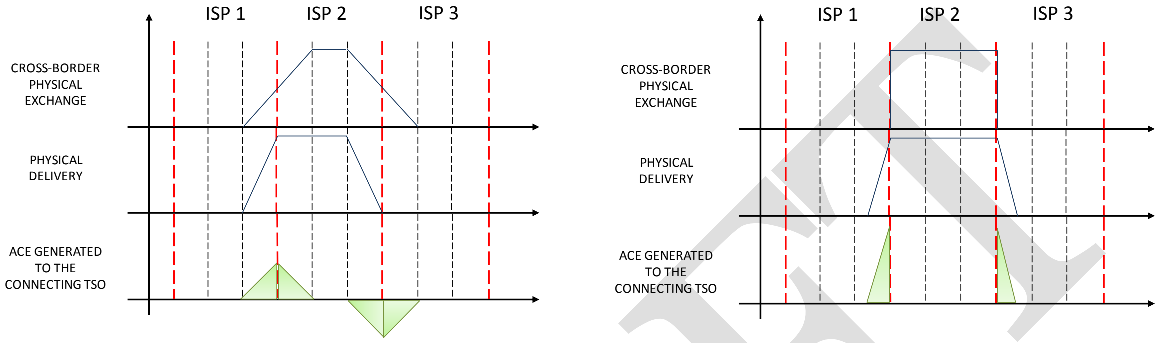
- **Block product**: the shape of the product is characterized with infinite ramps rates.

In both approaches there could be a difference between TSO-TSO product and BSPs delivery:

- in trapezoidal product, the predefined ex-ante ramping period does not necessarily correspond to all individual BSP capabilities,
- in block product, infinite ramps do not correspond to "physical BSP capabilities" apart from fast ramping units (Pumps) and fast demand response.

This difference will generate ACE for the connecting TSO as illustrated in the following figure:



6.3.1.1.2 *Value of the ramping period for the cross-border exchange*

In order to make a decision between the different options, TSOs have considered in details two different durations for the cross border exchange. :

- Option 1 : 10 min of ramping period
- Option 2 : 0 min of ramping period (infinite ramp)

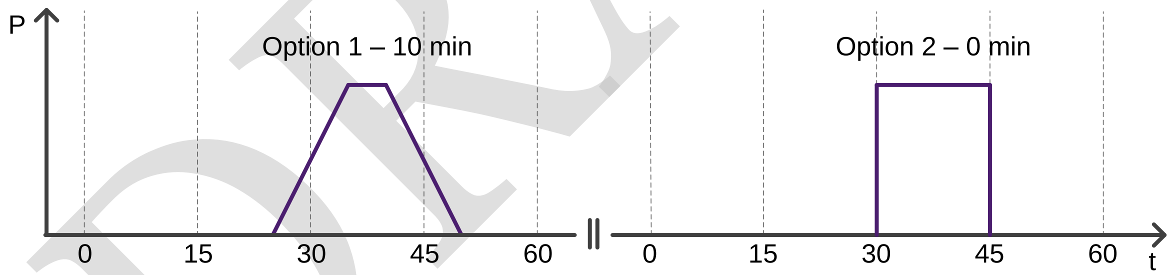


Figure 14 : Illustration of the two options for the ramp duration of the cross border echange

TSOs evaluated the two options according to the following criteria:

- **point of activation as close as possible to ISP:** With this criterion it is evaluated how close the point of activation can be to the ISP for which the bid was placed. The closer the point of activation to the ISP the shorter the GCT can be. Moreover the imbalance settlement price can better reflect the system status. Because of the ramp duration of 0 min option 2 can be 5 min closer to the ISP. (option 1: 0; option 2: 1);
- **consistency with other market timeframes:** Schedule exchange within Continental Europe is based on 10 min ramps. Consistency is a value itself and moreover consistent ramps for schedule exchange and for the exchange of mFRR lead to a better usage of interconnectors. (option 1: 1; option 2: 0);

- **applicable to HVDC interconnectors in most cases:** it is not possible to use ramps with a duration of 0 min at HVDC interconnectors. But it is also not possible to always use 10 min ramps, since some HVDC interconnectors have maximum ramp rates. Nevertheless in most cases a 10 min is applicable to HVDC interconnectors (option 1: 1; option 2: 0);
- **reduction of ACE by using a realistic power profile :** With this criterion it is evaluated which option reduces ACE due to the difference between the cross border exchange and the power delivered by BSP. On the one hand it is not known how fast BSPs can and do ramp up. On the other hand more BSPs will be able to ramp up within 10 min than ramping up within 0 min. Moreover incentives can be given for BSPs to ramp up within 10 min by this very fast BSPs will ramp up within 10 min. But it is not possible that BSPs which need a ramp duration of e.g. 10 min ramp up within 0 min even if strong incentives are given. It can be argued that this is criterion is not that important, since the amount of exchanged mFRR will be much smaller than the "normal" scheduled energy exchange (BRP adjustment) (option 1: 1; option 2: 0). But actually some countries think that even for mFRR it could be significant;
- **reduction of ACE based on mistakes of XB-exchange:** With this criterion the effect of both options on ACE due to a mistake in the XB-exchange is considered. It is assumed that in the controller of one TSO the exchange of mFRR due to a mistake is not considered. In the case of both options this mistake is detected at the same point in time, since there is a difference between the XB exchange profiles of the TSOs (assuming that TSOs exchange their XB profiles as a redundant control value). In the case of option 1 the ACE caused by this mistake has a 10 min ramp. Whereas in the case of option 2 the ACE induced by this mistake will immediately equal the exchanged mFRR. Moreover in the case of option 1 there is the possibility that this mistake is fixed within the 10 min, by this the ACE induced by this mistake will not reach the value of the exchange mFRR. (option 1: 1; option 2: 0).

Table 4: overview of the comparison of the two options

	Point of activation as close as possible to ISP	Consistency with other market timeframes	Applicable to HVDC interconnectors	Reduction of ACE by using a realistic power profile	reduction of ACE based on mistakes of XB-exchange
Option 1	0	1	1	1	1
Option 2	1	0	0	0	0

Table 4 gives an overview of the comparison of the two options. Since it is only evaluated which option is better fulfilling the criteria the range of scores is from 0 to 1.

TSOs didn't consider the following criteria:

- **possibility to use the potential of fast BSPs**: With option 2, block settlement and block BRP adjustment fast BSPs which can ramp up and down within almost 0 s (e.g. wind, solar, batteries) can be given incentives to ramp up within almost 0 s. On the one hand this can reduce ACE if the respective TSO has an ACE which is bigger than or equal to the activated mFRR. On the other hand this can increase ACE, if the respective TSO has an ACE which is smaller than the activated mFRR. This can be the case, if the TSO wanted to replace aFRR by mFRR. Therefore it cannot be said which option is the best to fulfill this criterion.

Conclusion

TSOs agree on a 10 minutes duration ramping period as used for exchanging "energy" between TSOs for all manual products. Nevertheless the definition of the cross-border exchange can be adapted in the future based e.g. on the observed behavior of the BSPs.

6.3.1.1.3 Process for the cross-border exchange

A direct activation is exchanged via:

- as part of the set point (In fact, when operating a virtual tie line not the setpoint Pset is adapted (this would imply a change of schedules according to the respective confirmation rules (see Policy 2), but a virtual measuring value Preal* is introduced and added to the other physical measuring values on the boundary of the control block) of the load frequency controller of the LFC area in case of exchange of Balancing Energy between LFC areas (called "virtual tie line"); or
- as part of the set point of the HVDC controller in case of exchange between non-synchronous areas.

A schedule-based product is exchanged via a schedule change:

- as part of the set point (In fact, when operating a virtual tie line not the setpoint Pset is adapted (this would imply a change of schedules according to the respective confirmation rules (see Policy 2), but a virtual measuring value Preal* is introduced and added to the other physical measuring values on the boundary of the control block) of the load frequency controller of the LFC area in case of exchange of Balancing Energy between LFC areas (called "virtual tie line"); or
- as part of the set point of the HVDC controller in case of exchange between non-synchronous areas; or
- based on the scheduling time period through scheduling process of LFC controllers of relevant LFC areas.

6.3.1.1.4 Proposal for the TSO-TSO cross-border physical exchange for manual products

In the following the cross border exchange for the manual products is proposed. Firstly for the merged mFRR product. Secondly for the RR product.

6.3.1.1.4.1 mFRR product

Background

TSOs suggest to use a 10 minutes ramp. Since the 15 min and the 10 min FAT product will be merged, the ramp for the cross border shape should not last longer than 10 minutes.

As mentioned before the definition of the standard products will be updated on a regular basis. Therefore it might be possible that the shape and especially the ramp duration will be updated based on the behavior of BSPs.

The merged product shall be a product which can be direct and schedule activated as it was foreseen for the 15 min FAT product.

Proposal

It is proposed to use the illustrated shape of the cross border exchange for the merged mFRR product.

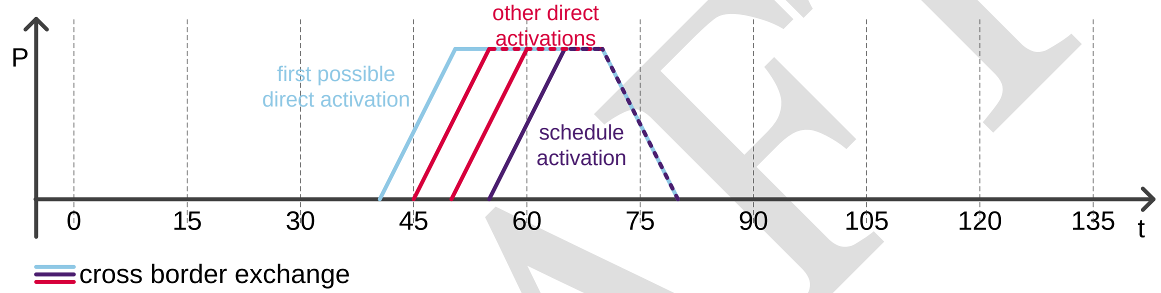


Figure 15: Illustration of the shape of the cross border exchange of the merged mFRR product with a ramp of 10 min and with the deactivation ramp symmetric to the boundaries of an ISP

6.3.1.1.4.2 RR product

Background

The shape of the cross border exchange was defined in the Terre project.

The shape is illustrated in Figure 16 for an activation lasting for 15 and others lasting for 30, 45 and 60 min. An activation of the product used in the Terre project can be up to one hour and has always to be equal to 15 min or a multiple of 15 min.

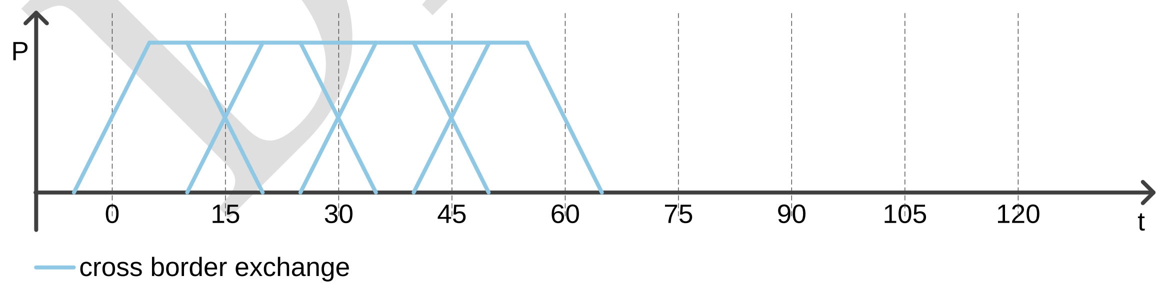


Figure 16: illustration of the shape of the cross border exchange for the RR project used in the TERRE project

Proposal

It is proposed to use the illustrated shape of the cross border exchange for the RR product.

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6.3.1.2 Automatic standard products

For the automatic product proposed, ENTSO-E distinguishes three main types of cross border exchange principles: control demand, control request and control target.

6.3.1.2.1 Control demand

General principles

The basic principles of control demand are listed below:

- the control demand represents the remaining disturbance after mFRR activation of each CA;
- measurement or simulation of the aFRR activation is necessary for control demand determination;
- the control demand is sent to the AOF;
- AOF calculates and sends a correction signal to the respective CA;
- in this concept coordination is done before controlling (automatically);
- correction signal is added to the ACE and represents the TSO – TSO exchange;
- TSO-TSO exchange is done step-wise (might be also done with a ramp limitation).

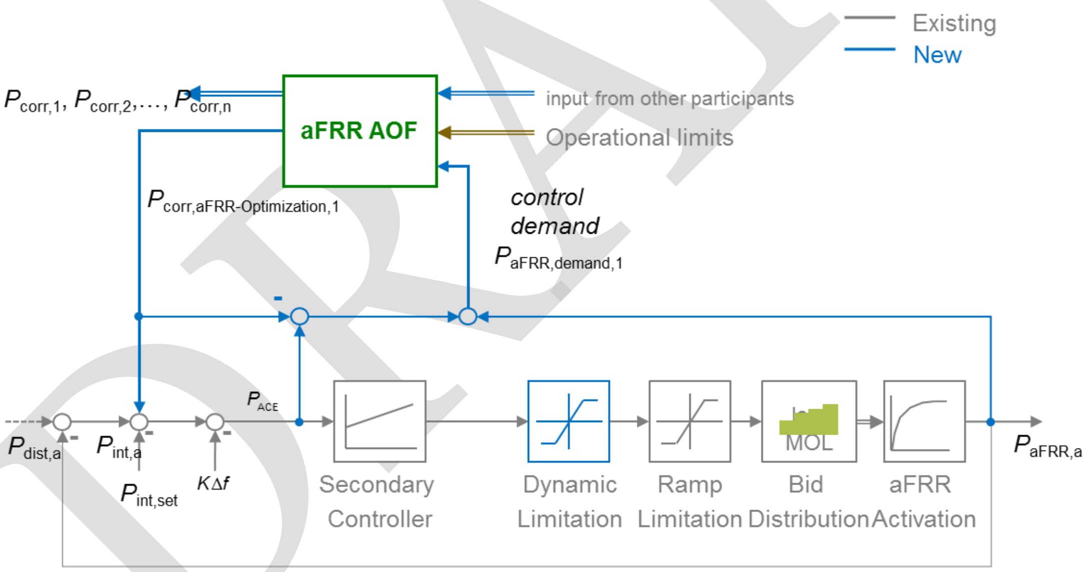

Figure 17: General principles for Control demand

6.3.1.2.2 Control request

General principles

The basic principles of control request are listed below:

- Control target of each CA is the input of the AOF;
- AOF calculates the control request based on nominated ramp limitations to the respective BSP via the related TSO;
- The TSO receives the individual control request for his local BSPs from the AOF and passes the value to the BSPs;

- The AOF sends a correction signal to each CA representing the TSO-TSO exchange;
- A fallback solution for the determination of control request and connecting the local controller with the local BSPs.

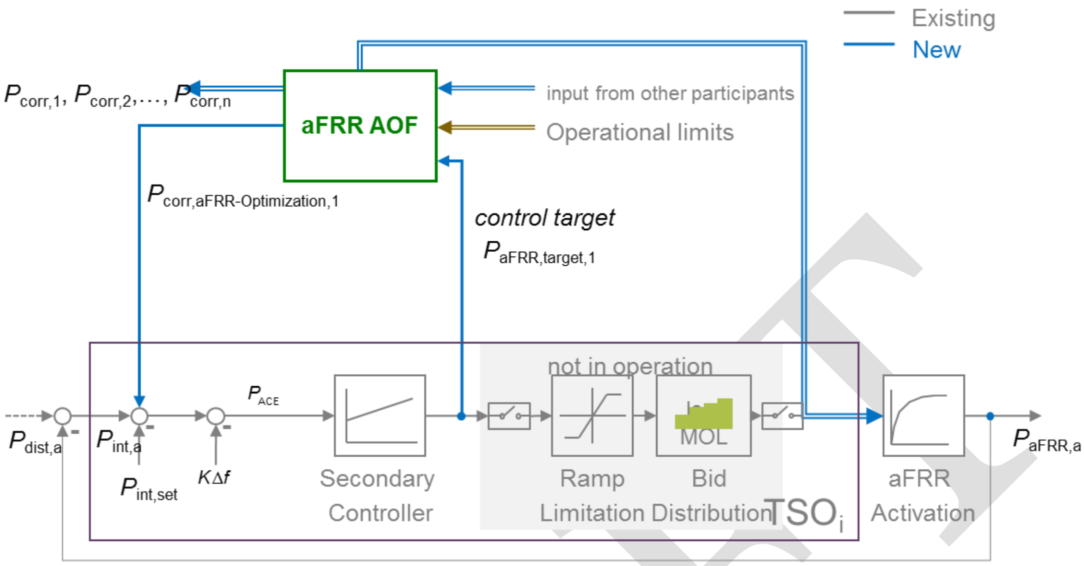

Figure 18: General principles for Control request

6.3.1.2.3 Control target

General principles

The basic principles of control target are listed below:

- Control target of each CA is the input of the AOF
- AOF calculates the control request based on nominated ramp limitations to the respective BSP via the related TSO
- The TSO receives the individual control request for his local BSPs from the AOF and passes the value to the BSPs
- The AOF sends a correction signal to each CA representing the TSO-TSO exchange
- A fallback solution for the determination of control request and connecting the local controller with the local BSPs

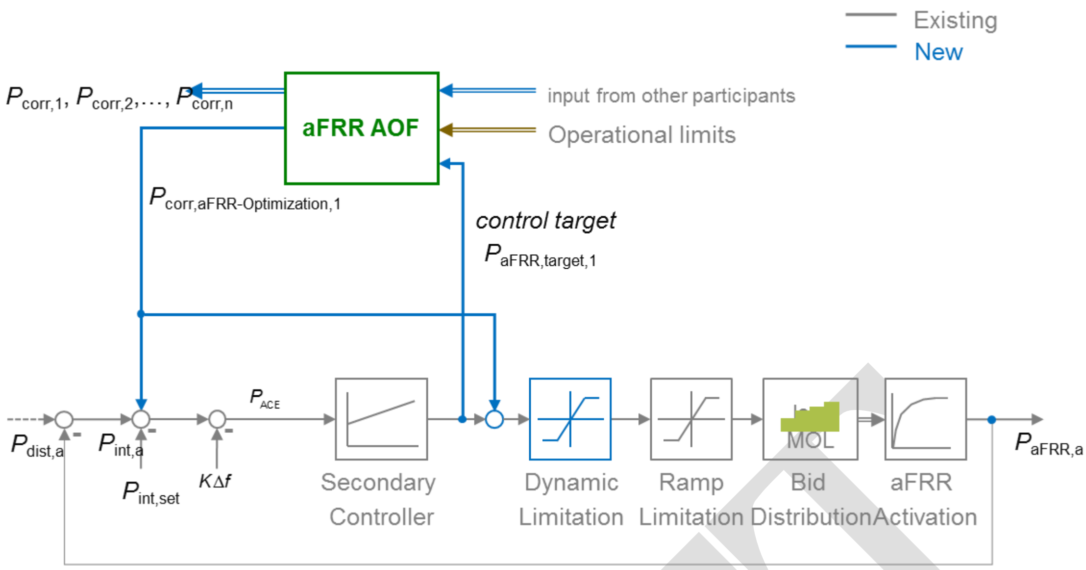

Figure 19: General principles for Control target

6.3.1.2.4 Comparison between the three types of cross border exchange

The three types of cross border exchangecan be assessed agains the following criteria:

	Control demand	Control request	Control target
Impact on ACE	Ramp limitations are a local decision and not needed for the concept The stepwise exchange affects the ACE (depending on CMO structure and overall demand) In case of no or fast ramp limitations the ACE remains good, even for an exporting TSO if the BSPs acts faster than the minimum requirement of the FAT which is shown by experience of systems applying this approach Under the assumption that there are no structural price differences, the effect on the local ACE of the TSO is limited. (previous market integration experience shows price convergence)	For calculation of control request for a bid, a fixed ramp rate based on the FAT is needed Local ACE is influenced by ramp limitations of BSPs in other CAs If a fixed ramp rate is applied, the BSP does not act faster than this ramp rate and the global ACE may increase. In the case that the BSPs nominate their possible physical ramp rate, the impact on the global ACE is reduced. Experience of TenneT Netherlands shows that faster ramp rates are not nominated	Less impact on local ACE than control demand

	ACE remains a local problem for the connecting TSO, depending on local controller settings and ramp limitations independently where the imbalance initially happened Shifting local ACEs between CAs, but no significant influence on the overall ACE		
Complexity	Knowledge of local ramp limitations is not necessary In case of outage no fallback solution necessary Interaction with IGCC perfectly possible Prevention of local CMO deviation increases complexity	Knowledge of local ramp limitations is necessary In case of outage fallback solution and detection of outage necessary Interaction with IGCC has to be investigated (in case of separate entities complexity increases due to congestion management) Coordination of local controller settings necessary	Limited level of complexity
Local responsability	Responsibility for local controller settings and ramp limitations remains at local level Responsibility to solve local ACE remains	The AOF is part of all feedback loops, is directly linked with the BSPs and therefore acts as a central controller. The local controller calculates only the input for the AOF. BSP activation from central entity – possible governance issue which has to be investigated	Responsibility to solve local ACE remains
CMO deviations	CMO deviations might occur due to local dynamics This CMO deviations can be prevented with a dynamic limitation The stability of the dynamic limitation is not proven yet	Prevents dynamic CMO deviations	Prevents dynamic CMO deviations
Stability	Stability is mathematically proven	Stability not proven theoretically neither in practice	Stability not proven theoretically neither in practice

	Local control loop is not affected – Parametrization considering local conditions possible GCC stable in operation since 2008	Coupling of two or more control loops with possible interaction might make the stability proof difficult	
Settlement	It uses metered values for settlement which may lead to discrepancies when determining cross border volume exchanged	It uses requested value for settlement which contributes to transparency and it may ensure physical neutrality	To be further investigated

6.3.2 TSO-TSO financial settlement

6.3.2.1 Manual products

Many options have been discussed between TSO for financial settlement of “exchanged balancing energy” when a bid is activated in the responsibility area of a TSO for the need of another TSO:

- use of a *trapezoidal* product or *block* product ;
- use of *requested* or *measured* balancing energy.where requested balancing energy refers to the energy activated by the CMOL whereas measured balancing energy refers to energy delivered by the BSPs (calculation based on metering data or methods of estimation).

During the discussions, three points were highlighted by TSOs:

- the requesting TSO should know ex-ante the volume of activated balancing energy which would be settled (in order to estimate the cost of its need) ;
- the connecting TSO should have a guarantee to receive a financial flow in relation with the selected bid and to be “as much as possible” financially neutral (when the BSP delivery is equal to the connecting TSO request) ;
- the shape of the “financial” flow could be different from the physical cross-border exchange as used for exchange of energy.

Conclusion

With a predefined ramping rate for the trapezoidal product or a block product, the two principles can be respected as long as the “settled energy” is equal to the resquested balancing energy (whatever the delivery from the BSPs is). Thus, for pragmatic reasons TSOs plan to use “block product” for financial settlement whatever the shape of the physical cross-border exchange is.

In case of partial or total failure of an activated bid, the connecting TSO should stay responsible for delivering the requested balancing energy to the requesting TSO. Therefore each TSO should develop in local terms and conditions, a mechanism in order to make BSPs support the financial consequences of their failures (see TSO-BSP financial settlement).

6.3.2.2 Automatic products

To be further assessed in the future discussions.

6.4 BRP and BSP settlement

6.4.1 General principles

6.4.1.1 Equality between BSP and BRP settled volume

According to article 46 of the GLEB it is on each TSO's hand to define its own process for settlement to its connecting BSPs:

"*Concerning the settlement of balancing energy and for at least the frequency restoration process and the reserve replacement process, each TSO shall establish a procedure for:*

- *the calculation of the activated volume of Balancing Energy based on requested or metered activation;*
- *claiming recalculation of activated volume of Balancing Energy.* "

Moreover according article 51(3) of the GLEB, the energy volume of imbalance adjustment corrected into the concerned BRP perimeters should be the same as settled balancing energy to the BSP:

"For each imbalance adjustment, each TSO shall determine the activated volume of Balancing Energy calculated pursuant Article 46(2) and the activation purpose if other than Balancing"

6.4.1.2 Options description

Many options have been discussed between TSO for BSP and BRP settlement of "activated balancing energy":

Option 1 – requested energy per ISP

The balance positions of the concerned BRPs are adjusted with the MWh requested on each ISP in the delivery period. The volume remunerated to the BSP is equal to the requested energy per ISP.

Option 2 –measured energy per ISP in the delivery period

The balance positions of the concerned BRPs are adjusted with the MWh delivered on each ISP included in the delivery period. The volume remunerated to the BSP is equal to the measured energy per ISP in the delivery period.

Option 3 – measured energy per ISP in the full delivery period

The balance positions of the concerned BRPs are adjusted with the MWh delivered in each ISP included in the full delivery period (from the start of the ramping period to the end of the desactivation period). The volume remunerated to the BSP is equal to the measured energy per ISP in the full delivery period.

Option 4 – all measured energy in main ISP

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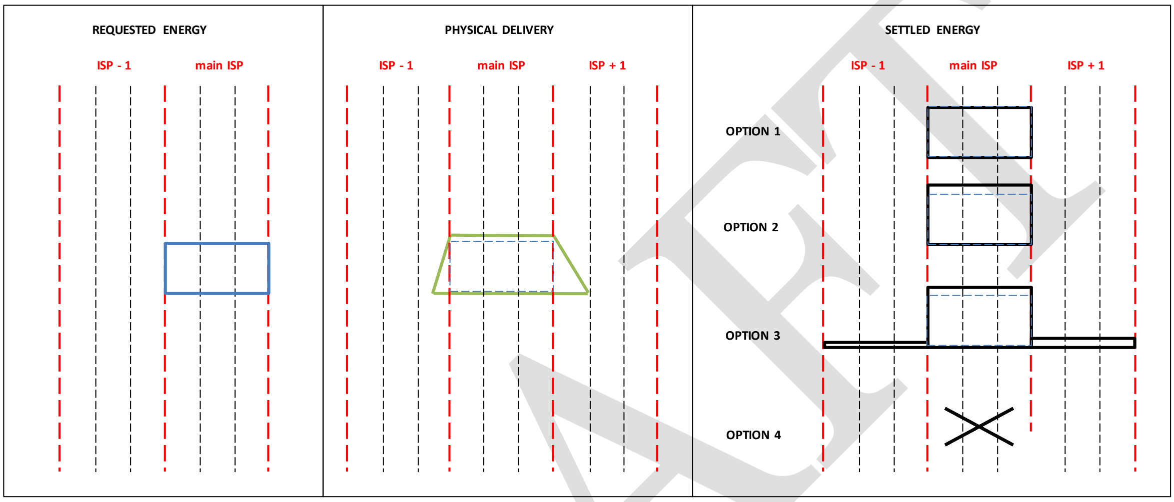
The balance position of the concerned BRPs are adjusted such that all measured energy in all the ISPs included in the full delivery period (from the start of the ramping period to the end of the desactivation period) is allocated to the main ISP. Thus it means that there will be no adjustment in the other ISPs. This option only concerns DA activated products.

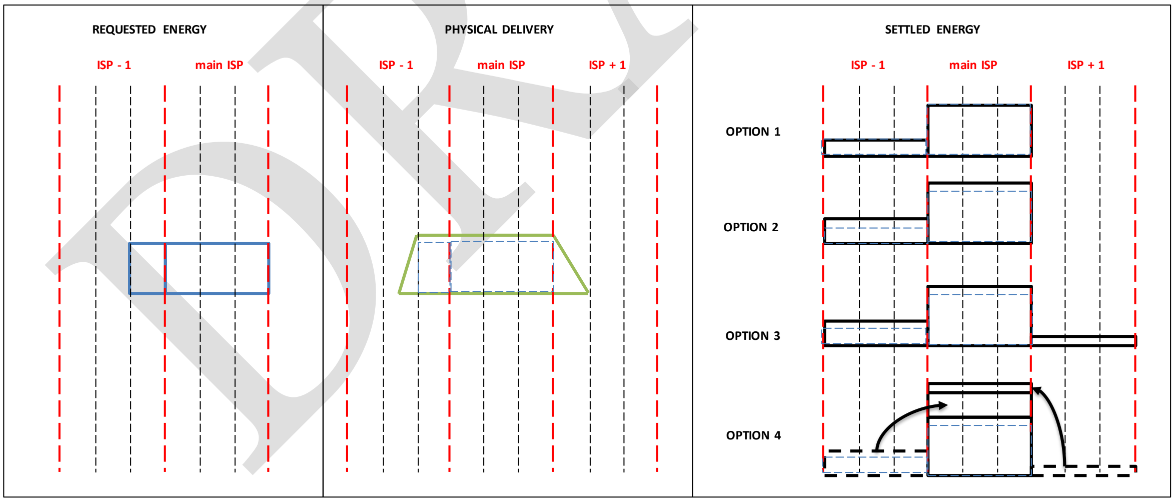
The volume remunerated to the BSP is equal to the measured energy per ISP in the full delivery period.

The following figures illustrates the 4 options for two types of activation:

- Scheduled activated bid



- Directly activated bid :



6.4.1.3 Analysis of the options

	Pro	Cons
Option 1	**For TSOs :** Financially neutral for TSOs	**For BSPs and BRPs**

		Could be a problem in case BRP and BSP are not the same Do not correspond to the physical "capabilities" of BSPs **For TSOs :** Does not give a specific incentive to respect the requested energy (difference between requested and delivered energy is settled as imbalance price)
Option 2	**For BRP :** Imbalance adjustment based on Real delivery during the delivery period, no impact on the BRP balance during the delivery period Each independant BSP activity is transparent for concerned BRPs during the delivery period **For BSPs** Allow existence of independent BSPs , and enhance demand side response Can be used to incentivize BSPs to deliver more energy (faster than the prequalification)	**For TSOs** Difference between TSO-TSO settlement and TSO-BSP settlement. Connecting TSO have to design an internal compensation mechanism to ensure its financial neutrality It is needed for TSOs to implement a methodology to calculate « delivered energy ». **For BRPs :** Impact on the BRP outside of the delivery period
Option 3	**For BRP :** Idem option 2 but during the full delivery period instead of only during the delivery period (including ramp-up and down) **For BSPs** Idem option 2	**For TSOs** Idem option 2 but not impact on the BRP
Option 4		**For TSOs** Idem option 2 **For BRPs :** Could be a problem in case BRP and BSP are not the same

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		Impact on the BRP position during the full delivery period

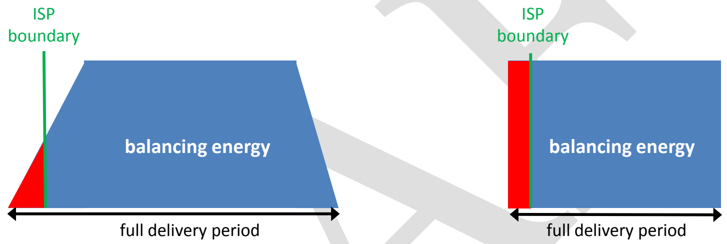
6.4.1.4 *Proposal*

To be further assessed in the future discussions.

6.5 Handling of balancing energy bids overlapping several ISPs

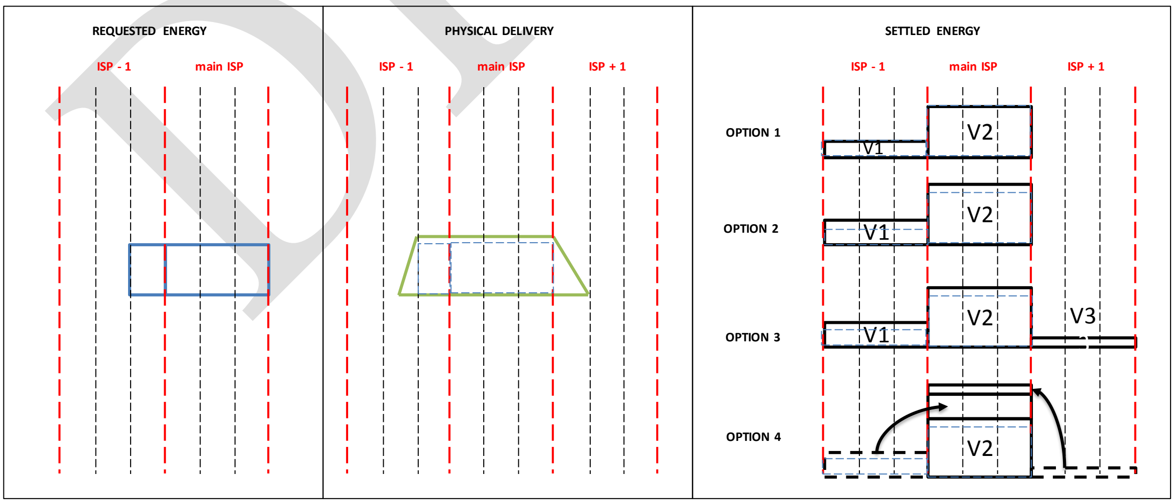
According to the defined standard product, bids submitted by BSP have one price (« bid price ») which is applicable for one period of 15 minutes called « main ISP» and which is be used for the clearing process to determine if the bid is activated or not.

If the bid can be either directly or scheduled activated, this price can also be used for « direct activation » just before or after the clearing process of the main ISP. In this particular case of « directly activated bids », part of the delivered energy will be out of the main ISP and will « overlap » several ISPs.



6.5.1 Options description

In the following sections the different options to settle energy outside the main ISP will be discussed thanks to the example of a direct activation of a mFRR bid overlapping ISP 1 and ISP 2.



Knowing *that:*

- the bids for "ISP-1" period are listed in CMOL1 ;
- the bids for "main ISP" period are listed in CMOL2 ;

- the volume of energy delivered during ISP-1 is called V1 and the volume of energy during main ISP is called V2 and the volume of energy during ISP+1 is called V3 ;
- the price from the clearing process of CMOL 1 is called P1 and the price for the clearing process of CMOL 2 is called P2 ;
- for the example the given direct activation is selected from CMOL 2, after the clearing process of CMOL 1 and before the clearing process of CMOL 2. The given direct activation could also has been selected from CMOL 1, after the clearing process of CMOL 1 and before the clearing process of CMOL 2.

Many options for settling energy inside outside the main ISPs could be used:

Option 1: P2

The volume of activated energy (V1+ V2) will be settled at the following price:

MAX (P2; Max price of DA activated bids between clearing of CMOL 1 and 2)

Option 2: Volume weighted average price

The volume of activated energy (V1 + V2) will be settled at the following price:

*(V1 *MAX (P1; Max price of DA activated bids between clearing of CMOL 1 and 2) + V2* MAX (P2; Max price of DA activated bids between clearing of CMOL 1 and 2)) / (V1+V2)*

Option 3: Combination of price of the bid & P2

The volume of activated energy (V1+V2) will be settled at the following price:

*(V1 *Price of the bid + V2* P2) / (V1+V2)*

Option 4: Combination of maximum DA activated bids & P2

The volume of activated energy will be settled at the following price:

(V1 * Max price of DA activated bids between clearing of CMOL 1 and 2 + V2* P2) / (V1+V2)

Other options ?

6.5.2 Criteria and analysis

To be further assessed in the future discussions.

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7. APPENDICES

7.1 Two different interpretations regarding the fulfilment of TTRF requirements

The full activation time for the mFRR product has to be fast enough to respect TTRF. Among TSOs, there is still some lack of clarity regarding the requirements the SOGL imposes on the FAT of this mFRR product, in other words on what is exactly meant by "fast enough to respect TTRF".At least two possible interpretations of the current rules were identified by TSOs:

Interpretation 1:

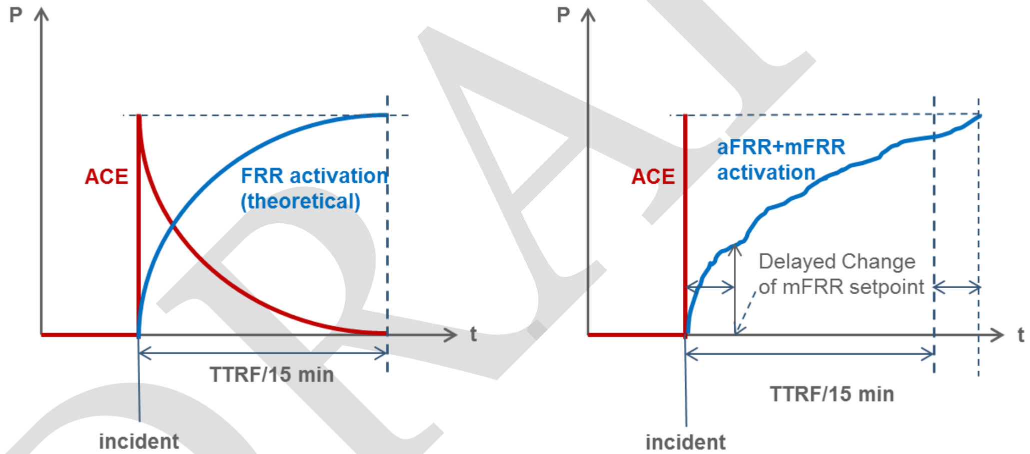
- The upcoming System Operations Guideline (SOGL) creates requirements around the TTRF in article 157 which establishes that the FAT of mFRR shall not be more than the TTRF (15 minutes)
- The SOGL establishes ACE (FRCE) quality requirements in Article 128 that all TSOs have to comply with, using their chosen products
- The provision in Article 3 (definition of TTRF) that any power imbalance smaller or equal to the reference incident needs to be resolved within TTRF is a design definition but not a strict requirement towards the TSOs. This point can be supported by the following points:
    - The currently applied trumpet curves do not impose to recover perfectly the frequency after 15 minutes
    - Art. 152.9 states that TSOs shall endeavour to avoid FRCEs which last longer than the time to restore frequency
    - Having at the same time statistical quality targets (Art. 128) and deterministic criteria is perceived as being inconsistent. Deterministic criteria would indeed overlook the other possibilities that can locally be implemented by a TSO to improve FRCE quality (mix of products, reserve dimensioning, activation of more (free) bids, BRPs' self-balancing, controller settings...)
    - Art. 158 specifies minimum technical FRR requirements and requires activation of contracted capacity within FAT i.e. between receiving request & full activation. Hence this does not specify time for TSO to activate. The TSOs are free to choose how to activate as long as quality targets are reached statistically.
- Hence, FAT could be equal to TTRF, also in cases when mFRR is needed to cover the reference incident as long as the preparation time on the TSO side does not cause uncompliant quality targets.

Interpretation 2:

- The provision in Article 3 (definition of TTRF) that any power imbalance smaller or equal to the reference incident needs to be resolved within TTRF sets a strict boundary condition for mFRR
- This was also the principle of the Operation Handbook. It's provisions were to be taken over into the SO-GL:
    - B-D5.3. Sizing of reserves according to largest possible generation incident
    - B-S2.1. Control Target for Secondary Reserve: MAX. 15 minutes ACE-correction
    - B-S4. If insufficient Secondary Reserve to deal with largest incident within this requirement, additional Tertiary Reserve to fulfil this needs to be available
    - Ergo: Tertiary Reserve (mFRR), if needed to cover the largest incident, needs to be able to be activated within 15 minutes – measured from the time of the incident.
- These requirements are reflected in the SO-GL
    - Art. 3:

- TTRF sets the MAX. time for ACE-correction to 15 minutes for CE (= Operationnal handbook)
    - Dimensioning incident = Largest generation incident of OH (= To be resolved within 15 minutes) addition from the SOGL: in both directions
  - Art. 157:
    - 2c: Additional clarification that FAT for FRR can never be > 15 minutes (already obvious from other provisions)
    - 2d: Size of dimensioning incident – same as already given in Art. 3
    - 2e/f: size of FRR shall cover dimensioning incident
    - 4: All TSOs shall have sufficient FRR reserve in accordance with the dimensioning rules
  - Art. 158:
    - 11f/g: FRR units or groups (manual & automatic) shall be able to be activated within the respective FAT
      - Ergo: If FAT = TTRF, all previous processes (before BSPS receives activation request) need to be accomplished in 0 [zero] time.

➔ 15 min. ACE recovery has to be guaranteed through the use of available products
  - No problem for CBs where aFRR reserves > reference incident
  - Potential problem where mFRR is needed to cover reference incident:



➔ If the FAT = TTRF the assumption is that recognition of the imbalance, activation procedures, IT-communication times (SUM = "TSO preparation time") is executed in 0 time.

➔ As this is not realistic, FAT needs to be smaller than TTRF in the extent of the TSO preparation time in order to be compliant with SO-GL.

➔ If the requirement for FCR minimum delivery is set to 15 minutes, this imposes a strong reliance on FRR resolving ALL imbalances after that point. Making the requirement to resolve imbalances within 15 minutes through FRR activation even more important.

7.2 Combined DA/SCH activations

7.2.1 Developing the concepts

Both concepts have the following common features:

a) Gate closure time: The balancing energy gate closure time is common for the SCH and DA bids.

b) Schedule only or schedule and direct activation: In both concepts a BSP can submit a bid marked as:

a) SA only;

b) SA and DA.

We offer this flexibility to BSPs as it may be possible for a BSP (for uncontracted bids only. contracted bids will be DA or SA or combination, in accordance with TSO requirements) to place only bids for schedule activations. For instance, let's assume that a BSP has a power plant with a capacity of 100 MW. This BSP sold 100 MW from 13:00–13:15, 50 MW from 13:15-13:30 and 100 MW from 13:30-13:45 on the intraday market. Therefore, only a scheduled activation of 50 MW would be possible from 13:15 to 13:30.

c) AOF: Both options use an activation optimization function (AOF) for direct and schedule activations.

i) **SCH AOF**: a market clearing - optimization - algorithm minimises the costs (maximises the social welfare) by satisfying the total balancing needs submitted to the AOF by the TSOs, i.e. the overall system costs for the ISP. It is also possible to net the TSO needs. Additionally, in the schedule activation there is simultaneous consideration of transmission capacity which leads to more efficient utilization of it.

ii) **DA AOF:** algorithm must work according to the first come first serve principle. That means the AOF minimizes only the cost for one TSO for the given balancing need, under the assumption that no netting is performed in the case of direct activation, since a direct activation is always done immediately.

iii) **Minimum and Maximum delivery period**: It is assumed in developing these concepts that the delivery period for SCH activation remains fixed at 15 minutes (both minimum and maximum), For the diagrams in this document the DA product is also given with a delivery period of 15 minutes for simplicity. There is any number of variations on how the rules could be set for DA or SCH with regard to delivery period and therefore we propose that further work will be done on this area to develop the concepts which are preferred.

Some of the other key considerations to take into account in relation to the solutions are:

- Validity of the CMOL: Which and how many CMOLs are available for activation at the same time
- The FAT and Validity period (possible delivery period)
- Bid firmness: it is related to the time the BSP must have the balancing energy bid available
- ATC usage and handling: when the transmission capacity is free to be used for direct activation and when for schedule activation

OPTION 1: DA followed by SCH

High-level process

The process is described in the following and illustrated in **Error! Reference source not found.**:

1. BSPs submit their balancing energy bids
2. ATCs for affected ISPs submitted
3. TSOs submit their balancing needs to be met by DA

4. The AOF calculates which bids are activated according to the first come first serve principle.
5. Each time a TSO uses the CMO for DA, ATC capacity and merit order list are updated.

Steps 3-5 are repeated on a continuous basis until the end of the validity period of the DA.

6. At the end of the validity period of the CMOL, the remaining balancing energy bids marked SA or both SA and DA, and the remaining ATC are submitted to the CMO for SA. Moreover TSOs submit their balancing needs to be met by SA.
7. A market clearing process – optimization function – runs considering the CMO with SA.
8. The results are: activated balancing energy bids, satisfied TSO balancing needs and remaining ATC to be used for the subsequent DA

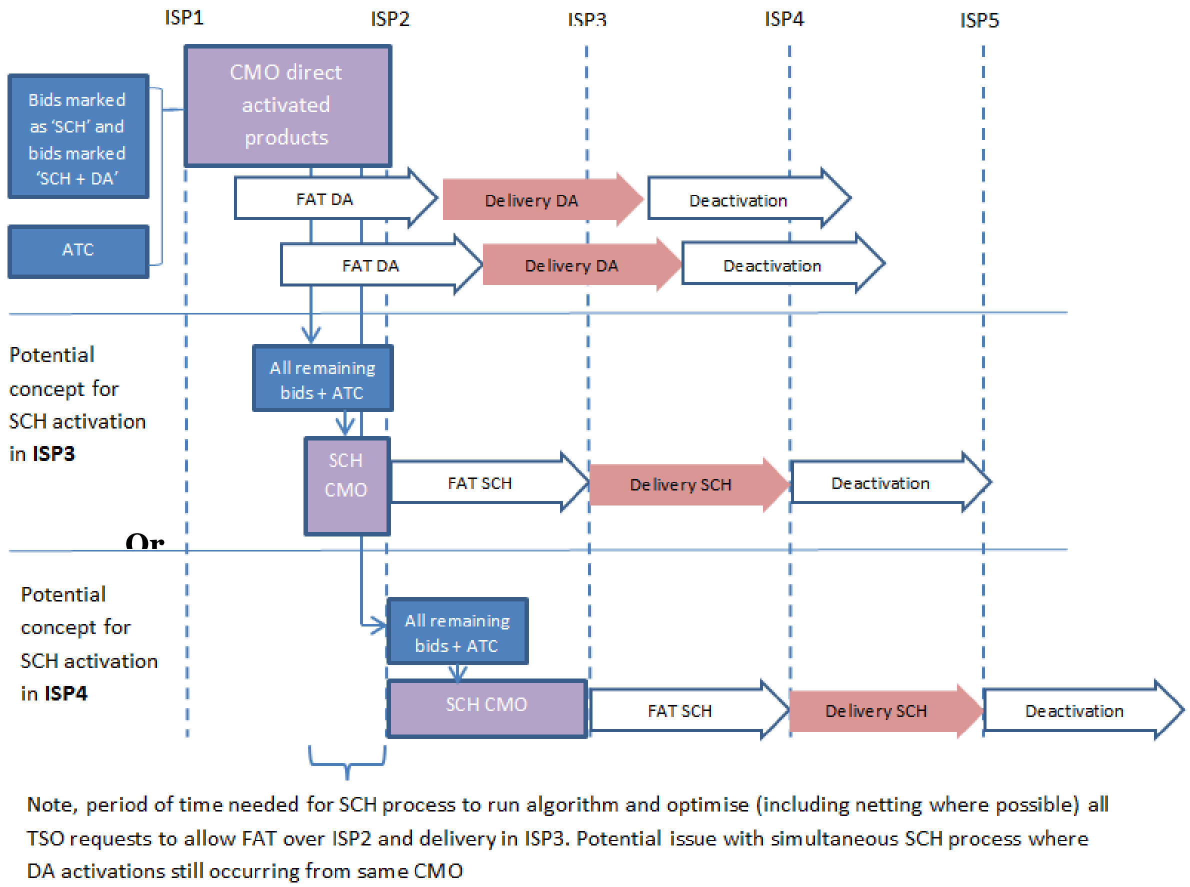


Figure 20: illustration of the high level process of option 1 with 2 potential concepts for SCH activation depending on whether process is designed with delivery in ISP3 or 4 preferred

OPTION 2

High-level process

The process is described in the following:

1. BSPs submit their balancing energy bids
2. TSOs submit their balancing needs to be met by SA

3. ATC for affected ISPs submitted
4. A market clearing process – optimization function – runs considering the CMO with SA.
5. The results are: activated balancing energy bids, satisfied TSO balancing needs and remaining ATC to be used for the subsequent DA
6. The remaining balancing energy bids marked as both SA and DA, and the remaining ATC are submitted to the CMO for DA
7. TSO balancing needs that must be met by DA can use the CMO for DA
8. Each time a TSO uses the CMO for DA, ATC capacity and CMO are updated

The process is illustrated in **Error! Reference source not found.**.

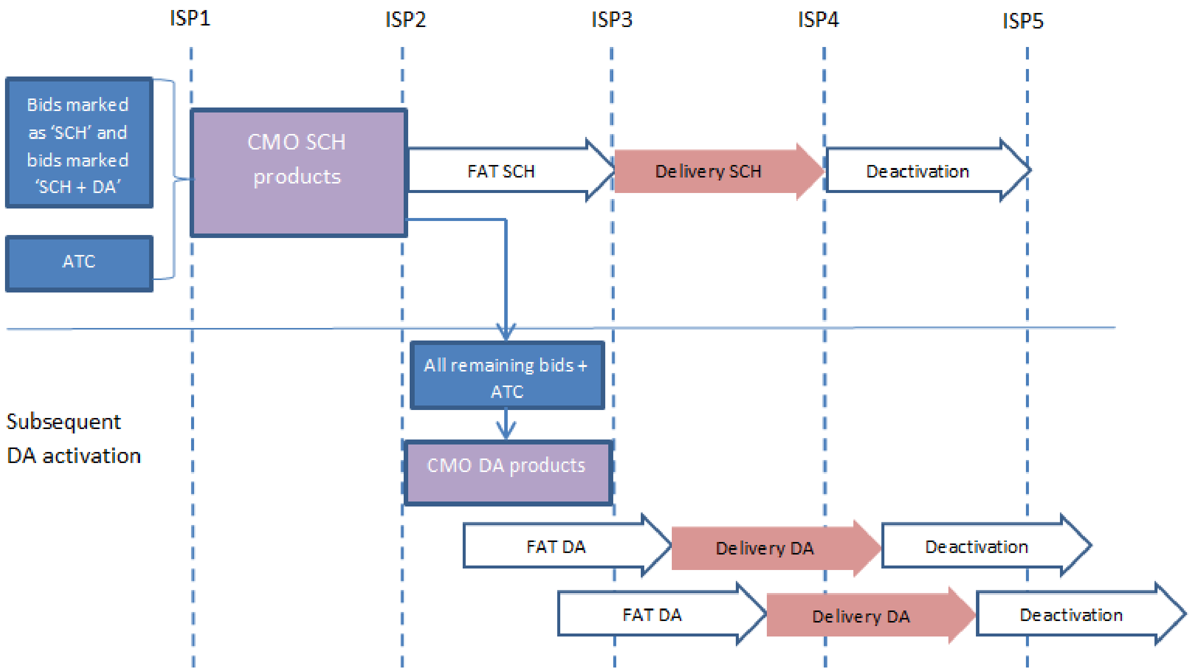


Figure 21: Overview of Option 2, Scheduled activations from CMOL taking place with remaining bids to be activated via DA

7.2.2 Evaluation of Concepts

The two questions we wish to answer are as follows:

Question 1: What order of activation provides the highest fulfillment of TSO needs and increases social welfare?

Question 2: How does the order of activation affect the number of ISPs over which a bid is activated?

To answer Question 1 there is a number of criteria which need to be taken into account to understand what the TSOs actually need and therefore which option may be preferred. These criteria can therefore be scored against for the two different options.

The first set of criteria can be summarized under the headline "**Maximizing flexibility**". It is important for TSOs that any product which combines DA and SCH activation allows the flexibility in activation that TSOs need to operate the system in real-time.

- ***Avoid usage of DA bids for schedule activation (keep flexible bids as long as possible to face unexpected imbalances)***: With this criterion it is considered that in the case of Option 2 it may be that a bid which can be directly activated is used for schedule activation, since it is cheaper than a bid which can only be schedule activated. Then this bid is not available for direct activation afterwards. By running the scheduled process first, flexibility for DA may be removed from the CMOL.

  - Option 1 gets better scores, since bids are used for direct activation first.

- ***Allow shorter GCT***: With this criterion it is considered when the bids need to be submitted in order to ensure the functioning of the whole process. In Option 1, as the bid can be activated one ISP before the "main" ISP, the GCT shall be at least 30 minutes before real time. In Option 2, as the bid can be activated during and after the "main" ISP, the GCT shall be at least 15 minutes before real time.

  - Option 2 gets better scores, since it allows a shorter GCT.

The following criteria can be summarized under the heading "**reduce costs**". TSOs are expected to optimize use of balancing energy and as a result, increase social welfare. The ability of each concept to enable this to happen is therefore important to consider.

- ***Maximize the benefits of netting by increasing the amount of schedule activations:*** With this criterion it is considered that more schedule activations are beneficial since netting can be used. The more netting that is used, activation of energy can be avoided and subsequent activation will have higher liquidity remaining in the CMOL. This should reduce overall costs and increase social welfare.

  - I***ncentivise TSOs to use as much as possible scheduled activation:***

    Scheduled processes give the opportunity for netting whereas DA do not permit netting of network or balancing needs. On the long term, the more TSOs use SCH activations, the more netting will be performed, thus reduction of costs, and subsequently the more efficient usage of ATC will be observed.

  - Therefore Option 2 gets better score since it gives this incentive to TSOs.

- ***Reduce risk of counter activations:*** With this criterion it is considered if the risk of counter activations due to e.g. long delivery periods is reduced/increased and by this costs are increased/reduced.

  - Options with short or flexible delivery periods are more advantageous for this criterion – this will be investigate further as part of the development of these concepts and subsequent work of maximum and minimum delivery periods.

The following criteria aims to address **Question 2: How does the order of activation affect the number of ISPs over which a CMOL is valid?** For some TSOs it is preferred that balancing energy is limited to delivery in as few ISPs as possible. We therefore consider the validity of each CMOL below

- ***Energy deliver in the valid ISP of the CMOL***: This criterion tries to evaluate if the energy is mainly delivered in the same ISP as the one which the CMOL refers to.

  - This criterion will depend on the defined maximum delivery periods for the products and therefore should also be investigated further. By limiting maximum delivery periods it may be possible to reduce the ISPs for which a product is activated.

  - For Option 1 this will depend on the ISP for which the SCH process is subsequently run, as illustrated in Figure 1.

    - Where the SCH process is absorbed into the end of ISP1 (and overlaps with the period in which the DA process is running for that CMOL), the delivery of the SCH product will be in ISP3, whilst the DA activation will deliver in ISP2 and 3.

        - Where the SCH process takes place in the next ISP and therefore only delivers in ISP4, no overlap will exist. The one CMOL will therefore allow delivery in 3 ISPs (DA in ISP 2 & 3, SCH in ISP 4)
    - For Option 2 the DA activation will be delivered in 2 ISPs; 1 of which overlaps with the SCH activation.
    - Both Options therefore score evenly given the potential to have the CMOL valid for 2 ISPs only.

It is important also to consider the **compliance of each concept with the requirements of the network code**.

- ***Compliance with EBGL:*** With this criterion it is considered if the variation of an option is compliant to EBGL.
    - Variation of options which don`t foresee that the BSP can be fully activated get worse scores.
    - Both options appear to allow BSPs to deliver Standard products and therefore should score evenly

Criteria which are not considered for evaluation but which have been discussed

Simultaneous use of ATC by DA and SCH: It is a problem that the calculation time of the AOF for schedule activation might be longer than the AOF for direct activation. By this there is a time period in which no direct activation can be done, since the AOF for schedule activation is running with fixed ATC values in this time period. If a direct activation would be done in this time period this would have an influence on the ATC values considered in the AOF for schedule activation. This is a problem affecting both options.

Efficient usage of ATC: With this criterion it is considered whether Option 1 or Option 2 lead to a more efficient usage of ATC. Since no approach to deal with this criterion could be found, this criterion is not considered for evaluation.

Flexibility of delivery period: With this criterion it is considered, how much the respective TSO can influence the shape of the delivered balancing energy. The flexibility of delivery period can be further investigated as part of the development of the concepts for the combined DA and SCH product. It is intended this criterion is investigated more in full in due course.

Incentives for BSPs to bid for direct activation: It is desirable that BSPs that technically are able to do direct activation also bid for direct activation, instead of bidding for schedule activation only, which would reduce the flexibility for the TSO. This criterion tries to quantify the incentive for a BSP to place a bid for both direct and schedule activation.

7.2.3 Summary

A summary of the outputs of the above criterion is given below. It should however be noted that ENTSO-E intends to further assess the two options in more detail with regard to delivery periods as well as potential cross-border exchanges.

	Option 1	Option 2

Maximizing flexibility		
Avoid usage of direct activated bids for schedule activation (keep flexible bids as long as possible to face unexpected imbalances)	1	0
Reduce costs		
Maximise the benefits of netting (of TSO power needs)	0	1
Others		
Delivered energy in the main ISP (energy mainly provided in the ISP where the CMOL refers to)	1	0
Possible to activate DA product at all times	0	0
Compliance with GLEB	1	1
Allow shorter GCT	0	1
Total score	3	3

7.3 Retracing the key steps of elaborating standard products

7.3.1 Initial set of standard products (January 2015) - global view of all products and reason behind

	P-DA-15-15	P-DA-20-10	P-DA-10-10	P-DA-5-5	P-DA-3-3	P-SCH-15-0	P-SCH-30-15	P-SCH-15-15	P-SCH-x-y
FAT	15	20	10	5	3	15	30	15	x
Min delivery	15	10	10	5	3	0	15	15	y
divisibility	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional

P-DA-15-15

We need a direct activated mFRR product, with a full activation time equal to 15 minutes (time to restore frequency in Continental Europe). Duration is proposed to be at least 15' (unless use link between bids), in relation with slowest common denominator of ISP in Europe (therefore, we will be able to activate such a bid within an ISP).

P-DA-20-10

We need a direct activated mFRR (Ireland) / RR(CE) product, with a full activation time equal to 20 minutes (time to restore frequency in Ireland). Duration is proposed to be at least 10' (unless use link between bids), in relation with TSO needs.

P-DA-10-10

We need a direct activated mFRR (UK) product, with a full activation time equal to 10 minutes (time to restore frequency in UK). Duration is proposed to be at least 10' (unless use link between bids), in relation with TSO needs related to small area, relative low stability and fast balance variation. Also the Nordic system requires fast mFRR products due to its strong dependence on mFRR. It does not mean than this product will not be used by other members.

P-DA-5-5

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We need a direct activated mFRRproduct, with a full activation time equal to 5 minutes. Duration is proposed to be at least 5' (unless use link between bids), in relation with TSO needs to cover short and fast imbalances.

P-DA-3-3

We need a direct activated mFRR product, with a full activation time equal to 3 minutes. Duration is proposed to be at least 3' (unless use link between bids), in relation with TSO needs to cover short and fast imbalances.

P-SCH-15-0

We need a scheduled mFRR(Continental Europe) energy product, with a full activation time equal to 15 minutes (time to restore frequency in Continental Europe). Duration is proposed to be 0', meaning that the product could in some cases physically reach the requested power and decrease immediately after. Exchanges between TSOs and settlement are only based on 15' scheduling. Duration in relation with slowest common denominator of ISP met in Europe (therefore, we will be able to activate such a bid within an ISP).

P-SCH-30-15

We need a scheduled RR product with a full activation time equal to 30 minutes (seems to be sufficient to cover BSP technical abilities and TSO needs). Standard duration is proposed to be 15' and could be extended by BSP by using links between bids. Such product will be activated only based on 15' scheduling process.

P-SCH-15-15

We need a scheduled RR product with a full activation time equal to 15 minutes (seems to be sufficient to cover BSP technical abilities and TSO needs). Standard duration is proposed to be 15' and could be extended by BSP by using links between bids. Such product will be activated only based on 15' scheduling process.

P-DA-x-y

TSOs propose this product for discussion in order to make BSP in the position to offer flexibilities not compatible with other standard products. It means that TSOs do not require specific values neither for Full Activation Time nor minimum delivery period. These values will be completed and defined by the BSP at gate closure time when offering the bid to the connecting TSO. Consequences in selection algorithms are that products are not so similar and difficultly comparable between each other. Therefore fair competition between BSPs and selection of bids by TSOs (algorithms) will be an important challenge for this product.

7.3.2 Evolution of the list of standard products

7.3.2.1 Liquidity, harmonised features and European potential

The first ENTSO-E thoughts led to propose a list of 9 standard products. This list has been discussed with ACER, stakeholders and EC as well. Many of the involved parties considered that the number of standard products was too important to develop liquidity on each product. Moreover ENTSO-E surveys to investigate on the possible use of standard products by TSOs leads to show that a limited number of the proposed standard products could be used by a majority of TSOs in Europe. It means that a few of the proposed products have a European potential for use and exchange, which in a way is not in line with the expectations of the network code.

Standard products

- should be as limited as possible
- should be as define as possible to allow products to be comparable within a CMOL
- should seek for European potential use

7.3.2.2 System operation guidelines evolutions and inputs

Other inputs linked with Load Frequency Control and Reserves and then System Operation guidelines have been considered. First ACER expects that TTRF will be harmonised to 15 minutes in Europe, which leads to remove some of the products defined to comply with synchronous area requirements.

7.3.2.3 Standard versus specific products

There is an inherent contradiction in some of the requirement of the network code and the needs of the TSOs: we need to cover most of power needs with the most reduced number of standard products. We have pointed out that the TSOs have different needs based on the physical characteristics of their systems. Combining this with the requirement to have few Standard Products and to let Standard Products cover the majority share of the TSO needs leads to inconsistencies. We can look at two available options:

- Keep a large number of Standard Products. This satisfies the perceived intention of the EBGL, but the number of products is assumed higher than what is preferred by ACER. Moreover, the requirement that all products should be used in all CoBAs is impractical and unnecessarily expensive, as it will require significant IT development for products that will not be used in several CoBAs;
- Reduce the number of Standard Products. This will satisfy the "limited number of products" requirement, and reduce the inadvertent effects of the "all products in all CoBAs" requirement. But then the Standard Products will not cover the major share of the TSOs' balancing needs in all regions.

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ENTSO-E analysed the possible reduction of the number of Standard Products. We agree with ACER that reducing the number of Standard Products reduces market fragmentation (between Standard Products). Nonetheless we identified that the reduction of products could be better for market liquidity and BSP competition up to a threshold. Indeed if we reduce drastically the number of Standard Products, several TSOs will not be able to cover all needs with Standard Products and will need to define specifics ones (it might become necessary for TSOs to shift some of the FRR to potentially more expensive aFRR to cover its needs). In this latter case the market fragmentation (specific / standard) will increase, and the cost of balancing as well. This description of an extreme case allows us to qualitatively illustrate that there is an optimal number of Standard Products to avoid market fragmentation. Both standard/specific and between standard fragmentation could be avoided with the relevant number of products.

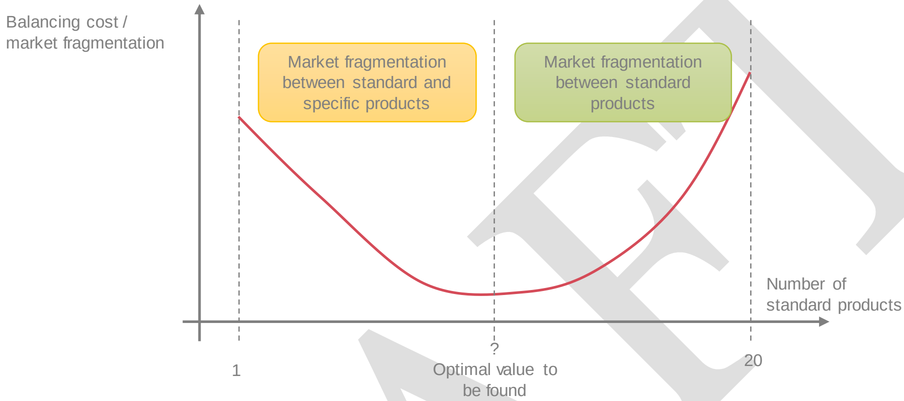

Figure 22: Illustration of the split between standard and specific products

The three requirements to the Standard Products are therefore not compatible, and at least one of them should be relaxed. One reason for the complication is that, as mentioned before, mFRR covers a small share of the total balancing needs in some regions (e.g. CWE), while it is the dominating process in the Nordic region and the UK. Obviously, there is a need for a broader range of products when manual balancing is the only or main process than when it covers only a small share of the total needs.