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# **Explanatory document to all TSOs' proposal to further specify and harmonise imbalance settlement in accordance with Article 52(2) of Commission Regulation (EU) 2017/2195 of 23 November 2017, establishing a guideline on electricity balancing**

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## **DISCLAIMER**

This document is submitted by all transmission system operators (TSOs) to all NRAs for information purposes only accompanying the all TSOs' proposal to further specify and harmonise imbalance settlement in accordance with Article 52(2) of Commission Regulation (EU) 2017/2195 of 23 November 2017, establishing a guideline on electricity balancing.

## Contents

1. Introduction .....	3
1.1 Interpretation and scope of the ISHP.....	3
2.1 The All TSOs' proposal .....	5
2.1. Article 1: Subject matter and scope .....	5
2.2. Article 2: Definitions and interpretation .....	5
2.3. Article 3: Calculation of an imbalance adjustment .....	8
2.4. Article 4: The calculation of a position, an imbalance and an allocated volume .....	10
2.5. Article 5: Components used for the calculation of the imbalance price .....	13
2.6. Article 6: Definition of the value of avoided activation of balancing energy from frequency restoration reserves or replacement reserves .....	20
2.7. Article 7: The use of single imbalance pricing.....	21
2.8. Article 8: Definition of conditions and methodology for applying dual imbalance pricing .....	22
Abbreviations .....	27
Appendices .....	28

## 1. Introduction

This document gives background information and rationale for the all TSOs' proposal to further specify and harmonise imbalance settlement in accordance with Article 52(2) of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (hereafter referred to as "EBGL"). The all-TSO proposal is hereafter referred to as "ISHP".

Imbalance settlement is applied throughout all European systems, and represents an annual value of approximately € 3.6 10<sup>9</sup>, based on an imbalance cost estimation of € 1 per MWh consumed (see Annex A).

Current imbalance settlement methodologies are non-uniform and may affect a level playing field for BRPs (and BSPs), at least between different countries. Current methodologies are deeply embedded in business processes and systems of TSOs, BRPs and BSPs, DSOs and other parties involved in data exchange. The (expected) imbalance prices and imbalance cashflows affect market participants, TSOs and grid users financially.

The general objective of imbalance settlement according to the EBGL is to ensure that BRPs support the system balance in an efficient way, and to incentivise market participants in keeping and/or helping to restore the system balance, according to the EBGL recital 17, rephrased in EBGL Art. 44(1)(c): the imbalance settlement shall provide incentives to BRPs to be in balance or help the system to restore its balance. The ISHP takes into account this dual, if not ambiguous, objective of imbalance settlement in the EBGL, as well as takes into account the provision of incentives to BSPs to offer and deliver balancing services, and the avoidance of distorting incentives to BRPs, BSPs and TSOs.

Imbalance pricing and settlement is just one of the elements of market design. Transparency, equal access to information before, during and after the ISP of delivery, balancing energy pricing and settlement, all contribute to a level playing field within and across nations. No ISHP can ensure by itself a level playing field across Europe for BRPs, for BSPs, or even between BRPs and BSPs, given the limitations above-mentioned.

### 1.1 Interpretation and scope of the ISHP

The ISHP is based on the implementation of the EBGL, and on the implementation of the balancing platforms as a consequence of the EBGL, so the ISHP prescribes the legal rights and obligations of all concerned *after* expiration of potential derogations and exemptions.

This means inter alia that: the ISP length is harmonized at 15 mins; there are no exemptions to balance responsibility; imbalance areas for the calculation of imbalances, and imbalance price areas for the calculation of imbalance prices have been established; the resolution of balancing energy bids is per ISP; the balancing energy gate closure time is harmonized to close to ISP of delivery; the balancing energy platforms have been established; single imbalance pricing shall be applied by default; each NRA shall ensure the financial neutrality of the TSOs under their competence as a result of the settlement processes.

The ISHP has to take into account explicitly unharmonised elements that are established in the EBGL (see also Annex B). These are inter alia: Art 52(3) of the EBGL allows to distinguish in the ISHP between self-dispatching models and central dispatching models; the choice in SOGL for a TSO to perform the reserve replacement process or not; the absence of a uniform definition of TSO demand for balancing energy; the calculation by the connecting TSO of the activated volumes of balancing energy from connected BSPs as metered or as requested volumes; NRA methodologies to ensure financial neutralisation of TSOs as a result of settlement processes; non-harmonized tariffication structures and tariffs, that all affect the playing field(s) for market participants across Europe.

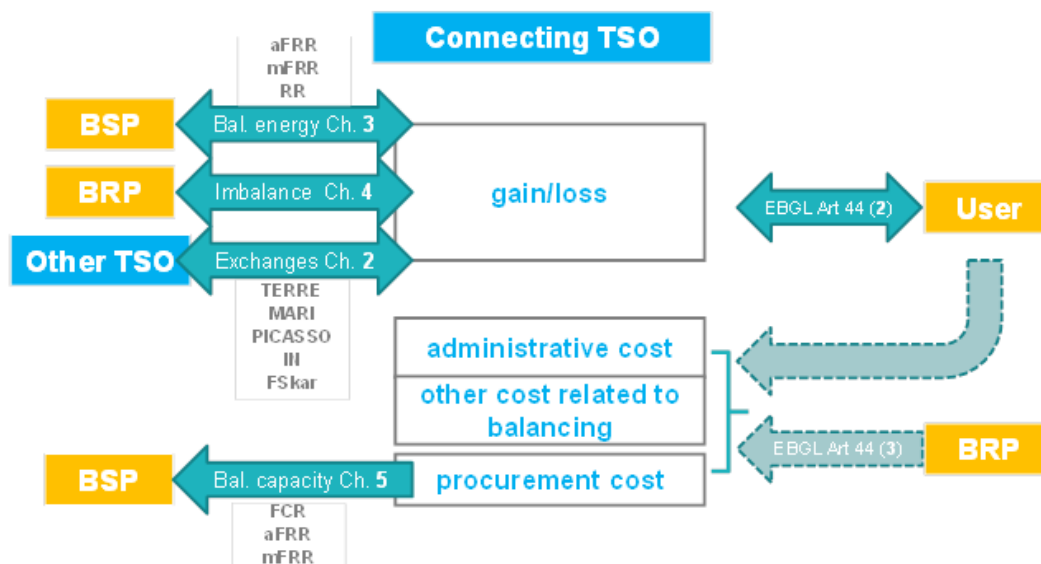
The ISHP does not address nor harmonise any additional rights and obligations of BRPs established in each TSO's terms and conditions for BRPs, or in connection agreements, that are not imposed by, or in scope of the EBGL.

The Article 52(2) of the EBGL contains a non-exhaustive list of subjects to 'further specify and harmonise'. The ISHP contains a proposal per subject, and each proposal will mention the applicability to either self-dispatching models or central dispatching models, or, by default, both. In this explanatory document, the order of subjects from the EBGL Article 52(2) will be maintained and the description of each proposal will explain the subjects and elaborate on the rationale followed by TSOs for selection of the individual proposals in the ISHP.

The implementation of the articles of the ISHP shall be done by each TSO, by amending their each TSO's terms and conditions for BRPs in such a way that they will be in line with the requirements of the proposal. Temporary, transitory stages are to be left to the discretion of TSOs and their NRAs, who will judge all intermediate steps proposed by TSOs towards full implementation of all elements of the EBGL.

At the same time there is little or no common or operational experience for all concerned (BRPs, BSPs, TSOs, NRAs) with some if not most of the target model of the EBGL of 15 minute ISP, 15 minute balancing energy bid resolution at least for FRR, that together with harmonized balancing energy gate closure time may result in much more dynamic (common) merit order lists. In addition there is currently little common operational experience with X-Border activation of balancing energy bids, nor with the settlement.

All these aspects are outside the scope of this ISHP, yet may have considerable impact on the cashflows of BRPs, BSPs, TSOs and grid users, as currently foreseen in in the target model in accordance with the EBGL:



**Figure 1** Cashflows resulting from EBGL and involving TSOs (or third parties entrusted with such settlements). BRP, BSP and TSO are according to EBGL; User is the tariff payer. Arrows denote direction of cashflow. Settlements may involve bidirectional cashflows, hence the double arrow. Numbers within the arrows without brackets refer to the respective chapter in EBGL Title V. In the absence of (optional) application of EBGL Art 44 (3) remuneration of procurement cost of balancing capacity, administrative cost and other cost related to balancing are considered to be remunerated by the user (tariff payer).

For this reason it is considered that the ISHP should not prematurely lock in details of imbalance pricing and settlement.

Moreover, the EBGL does not request uniform imbalance settlement methodologies, and secondly Article 6 of the EBGL allows all TSOs to request for an amendment of methodologies later on.

## 2.1 The All TSOs' proposal

### 2.1. Article 1: Subject matter and scope

The ISHP Article 1 (2) sets the scope for applicability of imbalance settlement as applying to all present and future imbalance areas and ISPS.

#### Applicability

The applicability of this scope applies to both central dispatching and self-dispatching models.

#### Legal background

The network code for on electricity emergency and restoration allows for imbalance settlement rules established on a national basis that deviate from those in accordance with the EBGL and the ISHP.

#### Alternatives

The alternative is to develop a harmonized set of imbalance settlement rules that would apply to all.

#### Argumentation

Since the responsibility to develop imbalance settlement rules that deviate from those in accordance with the EBGL and the ISHP is national and since there is no explicit requirement for harmonization the alternative is not considered in the ISHP.

### 2.2. Article 2: Definitions and interpretation

The ISHP provides a list of definitions of terms that:

- a) are not specified explicitly in EBGL, and
- b) are necessary for and used in the proposal and this explanatory document.

The following terms are defined in the ISHP:

- (a) Single imbalance pricing
- (b) Dual imbalance pricing
- (c) Scheduling unit
- (d) Aggravating imbalance

#### Legal proposal 'Single imbalance pricing'

'Single imbalance pricing' means that, for a given ISP in an given imbalance price area, the price for negative imbalance and the price for positive imbalance are equal in sign and size.

#### Applicability

The definition of single imbalance pricing applies to both central dispatching and self-dispatching models.

### **Legal background**

EBGL Article 55 (2)(c) states:

the use of single imbalance pricing for all imbalances pursuant to Article 55, which defines a single price for positive imbalances and negative imbalances for each imbalance price area within an imbalance settlement period.

### **Alternatives**

There are no alternatives to definition of single imbalance pricing as prescribed in EBGL Article 55 (2)(c).

### **Argumentation**

Without alternatives, and with a legal requirement no further argumentation is required.

### **Legal proposal 'Dual imbalance pricing'**

'dual imbalance pricing' means that, for a given ISP in a given imbalance price area, the price for negative imbalance is not equal to the price for positive imbalance in sign and/or size

### **Applicability**

The definition of single imbalance pricing applies to both central dispatching and self-dispatching models.

### **Legal background**

The term dual imbalance pricing is used in EBGL Art 18(7)(g), Art 55(2)(d)(i) and (ii), dual imbalance pricing in Article 55(2)(d). In all cases it concerns an imbalance pricing methodology that is not single imbalance pricing.

### **Alternatives**

For a given ISP in a given imbalance price area there shall be an imbalance price for imbalance surplus, and an imbalance price for imbalance shortage; these prices either are identical, -single imbalance pricing-, or they differ. There is no alternative to these two possibilities.

### **Argumentation**

To enhance clarity the term dual imbalance pricing is defined, and used throughout the ISHP.

### **Legal proposal 'Scheduling unit'**

A concept for which additional explanations to the definition might be helpful is scheduling unit, applicable to central dispatching models.

'Scheduling unit' means a unit representing a power generation module, a demand facility or a group of power generating modules or demand facilities for which a position, an imbalance adjustment, an allocated volume, an imbalance and an imbalance settlement are determined in a central dispatching model

### **Applicability**

The definition of 'scheduling unit' applies to central-dispatching model only.

### **Legal background**

EBGL Article 49(2) states the following:

*"for imbalance areas where several final positions for a single BRP are calculated pursuant to Article 54(3), an imbalance adjustment may be calculated for each position".*

EBGL Article 54(3)(c) states the following:

*“in a central dispatching model, a BRP can have several final positions per imbalance area equal to generation schedules of power generating facilities or consumption schedules of demand facilities”.*

### Alternatives

There are no alternatives for this definition in EU Directives or Regulations.

### Argumentation

The scheduling unit (SU) is a way to represent physical resources for the needs of the following processes in the central dispatching model: system planning, real-time system operation and settlements. Scheduling unit may consist of set of one or more resources. The configuration of the SU is determined by the TSO in consultation with the relevant DSOs (if needed, i.e.: if the physical resources of the SU are located in the distribution network) and the Balancing Responsible Party of this unit. In some central-dispatching models, cross-border import and export points are treated as respectively generating facilities and demand facilities.

As part of the processes implemented on the Balancing Market, the following values are determined for each Scheduling Unit for each ISP:

- a) Position – as the declared by BRP energy volume of a scheduling unit used for the calculation of its imbalance;
- b) Imbalance adjustment – as all volumes activated by connecting TSO for at least the following purposes: balancing, congestion management, required reserve level re-building, system defence plan instructions and TSO-TSO remedial actions;
- c) Allocated volume – as all injections and withdrawals of a set of resources attributed to that scheduling unit;
- d) Imbalance – as the difference between the allocated volume attributed to that scheduling unit and the final position of that scheduling unit, including any imbalance adjustment applied to that scheduling unit;
- e) Imbalance settlement – as the product of the imbalance and imbalance price.

### Legal proposal 'Aggravating imbalance'

'aggravating imbalance' means in case of self-dispatching models, the imbalance of a BRP in a given imbalance price area and a given ISP, that is opposite in sign to the net volume of balancing energy demand of the connecting TSO or connecting TSOs for that imbalance price area and ISP. In case the net volume of balancing energy demand of the connecting TSO or connecting TSOs for that imbalance price area and ISP equals zero (0), any imbalance of respectively of a BRP is accounted as aggravating imbalance.

'aggravating imbalance': means in a central-dispatching model the imbalance of a scheduling unit of a concerned BRP, in a given or imbalance price area and a given ISP, that is opposite in sign to the net position of the imbalance price area equal to net volume of the internal and external commercial trade schedules as well as imbalance adjustments minus total allocated volume of all scheduling units localized in the concerned imbalance price area. In case the net position of the imbalance price area for a given ISP equals zero (0), the imbalance of a scheduling unit located in this imbalance price area is accounted as aggravating imbalance.

### Applicability

The definition of aggravating imbalance applies to both central dispatching and self-dispatching models.



## Legal background

Firstly, the EBGL Article 52 (3) states that the ISHP may distinguish between self-dispatching models and central dispatching models. The EBGL Article 55 (2)(a) requires the ISHP to further specify and harmonize at least inter alia an imbalance. The ISHP uses the term 'aggravating imbalance' to identify the for a given ISP and a given imbalance the direction of imbalance, surplus or shortage, that effectively increased the connecting TSO or connecting TSOs demand for balancing energy. By default it identifies the non-aggravating imbalance as well. Specifying the aggravating direction in a definition in the ISHP allows for a harmonized target model. Relating the aggravating character to the balancing energy demand is consistent with the boundary conditions to the imbalance price in accordance with the EBGL Article 55(4) and (5).

## Alternatives

The aggravating direction is defined by the direction of net balancing energy demand of the connecting TSO or TSOs in case of self-dispatching models or by the direction of net imbalances of all scheduling units located in the imbalance price area in case of central-dispatching models. Alternative to this approach are the net imbalance of the connected BRP or BRPs in this imbalance price area in case of self-dispatching models, while no viable alternative exists for central-dispatching models.

## Argumentation

The balancing energy demand of the connecting TSO or connecting TSOs in an imbalance price area is known in real time. The net imbalance of the connected BRPs neglects any imbalances that are not attributable to a BRP yet affect the system balance, like ramping or tripping of socialized HVDC links.

This definition of aggravating imbalance can be used in selecting a single boundary condition to the imbalance price in case of single imbalance pricing, under application of Article 55(6) of the EBGL, thus further strengthening imbalance settlement harmonization in the target model. In central dispatching models the balancing energy demand of the connecting TSO or connecting TSOs in an imbalance price area is not necessarily known in real time, as it may be calculated at the LFC Area level especially in case of automatic Frequency Restoration Reserves. In this case, it would not be possible to split the whole LFC Area balancing energy demand between imbalance price areas if more than one imbalance price areas are adopted in the LFC Area considered. For this reason the sign of the net position of the imbalance price area must be determined through an alternative way taking into account the imbalance (position including the imbalance adjustment minus allocated volume) of all scheduling units in the imbalance price area.

## 2.3. Article 3: Calculation of an imbalance adjustment

### Applicability

The ISHP for specification of imbalance adjustment calculation applies to both self-dispatching models and central dispatching models. The application of imbalance adjustments in the target model is to a BRP in self-dispatching model and, in accordance to the ISHP Article 3(3) to the scheduling unit of a BRP in central dispatching model.

### Legal background

EBGL Article 52(2)(a) requires a proposal to further specify and harmonise, at least:

*“the calculation of an imbalance adjustment pursuant to Article 49 and the calculation of a position, an imbalance and an allocated volume following one of the approaches pursuant to Article 54(3)”.*

EBGL Article 52(2)(a) gives a non-exhaustive list of items to be specified and harmonised, a.o.: imbalance adjustments to a BRP in self-dispatching model or to scheduling unit of concerned BRP in central dispatching model.



EBGL Article 49(1) requires all TSOs to apply an imbalance adjustment for each activated balancing energy bid, i.e.: balancing energy, which is specified in proposal Article 3(1)(a).

EBGL Article 49(3) requires all TSOs to apply an imbalance adjustment for any volume activated for other purposes than balancing, which is specified in proposal Article 3(1)(b). This refers to the activation of balancing energy bids for other purposes than balancing, but also to redispatch actions, remedial actions, margin restoration and others that do not activate balancing energy bids; hence the absence of 'balancing energy' in this component (b) from Article 3(1) of the ISHP.

The non-exhaustivity of the list of items to be specified and harmonised in EBGL Article 52(2)(a) (hence the words "at least" there), allows for a harmonised specification of specific other imbalance adjustments in proposal Article 3(2). Since curtailment in accordance with CA, and emergency and restoration procedures in accordance with NC ER, are out of the scope of this proposal, these adjustments should be allowed, but cannot be made mandatory, hence the word "shall, if relevant". Additionally, adjustments may be made according to each TSO's terms and conditions for BRPs, for example to transfer redispatch or renewable energies between DSOs, TSOs and BRPs, that go beyond the activation of balancing energy bids for other purposes.

### Argumentation

Imbalance adjustment of balancing energy serves a dual purpose:

- a) Without imbalance adjustment, balancing energy delivered would end up as imbalance for one or more BRPs in self-dispatching model or one or more scheduling units in central dispatching model, thus weakening any incentive to deliver balancing energy.
- b) With imbalance adjustment, non-delivery of balancing energy would end up as imbalance for one or more BRPs in self-dispatching model or one or more scheduling units in central dispatching model, thus enhancing incentives to deliver balancing energy.

The determination of balancing energy volume is unharmonised by the EBGL, as it allows its determination using either requested or metered volume, in accordance with EBGL Article 45(1)(a). Since settlement of balancing energy is subject to separate proposal, the ISHP shall use the volumes of balancing energy determined by the TSO to be settled between TSO and concerned BSP in accordance with EBGL Article 45(3) as input for the imbalance adjustment.

This guarantees that all trades between BRPs, and all trades between TSOs and BSPs, are accounted for, without gaps and overlaps, in the total allocated volumes, representing all physical injections and withdrawals from BRPs. It ascertains equality of volumes settled in balancing energy imbalance adjustments, which enables direct comparison of balancing energy value and imbalance value by price comparison.

The harmonised approach within this proposal contributes to a level playing field for BRPs and BSPs across Europe.

The proposal's Art. 4 ensures the obligation of the TSO to inform the BRP on the imbalance adjustment, and thus the right of the BRP to be informed, thus contributing to a level playing field for all BRPs. When developing the ISHP, differences between the imbalance settlement practices among the TSOs were surveyed (see Annexes C and D) and found to vary amongst the TSOs. The finalisation time of the initial settlement and the billing date for the imbalances are important features from the BRPs' point of view, as it is having a straight effect to the BRPs' cashflow. The EBGL is not requiring harmonisation for the finalisation time of imbalance settlement and as the changes for finalisation time would probably need changes with the data delivery deadlines with DSOs or third parties involved, the current time schedule for harmonisation of imbalance settlement set by the EBGL might be too tight and the all TSOs' ISHP is therefore not harmonising the finalisation times. It should be noted that in the future it would be beneficial to have a harmonised maximum period and different possibilities for it should be analysed.

## 2.4. Article 4: The calculation of a position, an imbalance and an allocated volume

### Applicability

The all TSOs' proposal Article 4 applies to both central dispatching and self-dispatching models. The position, imbalance and allocated volumes in the target model apply to a BRP in self-dispatching model and to the scheduling unit of a BRP in central dispatching model.

For a central dispatching model, the solution shall be applied based on Article 54(3)(c) such that each scheduling unit shall have a single position as, in a central dispatching model, one BRP can have several scheduling units and therefore several positions, several allocated volumes, several imbalance adjustments and several imbalances, i.e. one per scheduling unit.

### Legal background

EBGL Article 52(2)(a) requires a proposal to further specify and harmonise at least:

*“the calculation of an imbalance adjustment pursuant to Article 49 and the calculation of a position, an imbalance and an allocated volume following one of the approaches pursuant to Article 54(3)”*

A breakdown in individual components results in a proposal to further specify and harmonise the calculation of:

- a) an imbalance adjustment, pursuant EBGL Article 49, and
- b) a position;
- c) an imbalance; and
- d) an allocated volume,

following one of the approaches pursuant EBGL Article 54(3).

Article 52 (3) allows the ISHP to distinguish between self-dispatching and central dispatching models that is proposed in the ISHP Article 4.

### Alternatives

The calculation of an imbalance is already exclusively defined by the EBGL.

The EBGL states in 52(2)(a) that the calculation of a position in the self-dispatching model, prior to implementation of the ISHP, shall be done following one of the approaches pursuant to Article 54(3), which are:

- a) *BRP has one single final position equal to the sum of its external commercial trade schedules and internal commercial trade schedules*
- b) *BRP has two final positions: the first is equal to the sum of its external commercial trade schedules and internal commercial trade schedules from generation, and the second is equal to the sum of its external commercial trade schedules and internal commercial trade schedules from consumption*

For the central-dispatching model the balancing guideline is not giving such a choice as for the self-dispatching model, instead Article 54(3)(c) states that:

- c) *in a central dispatching model, a BRP can have several final positions per imbalance area equal to generation schedules of power generating facilities or consumption schedules of demand facilities.*

### Argumentation

The proposal to apply a single position for self-dispatching models contributes to a level playing field on the following counts:

- The choice of a single position ensures that for imbalance settlement in self-dispatching model, all connections are treated equally, by:
  - removing the requirement for BRPs to distinguish between connections on load, generation or storage;
  - eliminating the requirement for TSOs to verify such distinctions;
  - simplifying the allocation process.
- In a self-dispatching model, the single position enables easier control of imbalances by BRPs.
- For ancillary service markets, single position for self-dispatching model simplifies determining the imbalance adjustment for aggregated bids, as their volume can be treated as whole instead of dividing the bid volume in the imbalance adjustment for consumption and production.
- Single position is simple and, as shown in ENTSO-E's Survey on Ancillary Services Procurement and Electricity Balancing Market Design for year 2016, single position is already used by majority of the Member States.

The proposed use of a single position for imbalance settlement in self-dispatching model concentrates on the use of information for the purposes of calculating the imbalance and not the actual notification process. The actual notification process is considered out of scope of the EBGL, thus the ISHP does not address the actual notification processes currently used. However, a simplified notification process is regarded as beneficial to new entrants, but may require IT changes for TSOs and existing BRPs which may not bring significant benefit and result in costs to implement that will fall eventually to the consumers but not changing the financial results for BRPs.

The proposal to apply for central dispatching models a single position for scheduling unit while one BRP can have several scheduling units per imbalance area is motivated by following reasoning: the adoption of one final position per scheduling unit for imbalance settlement purposes ensures more control of the security of the system by the TSO, as in central-dispatching model security of the system is strongly impacted by the locational distribution of scheduling units and their imbalances over the grid.

The adoption of one final position per scheduling unit for imbalance settlement purposes does not anyhow prevent aggregation of resources in the ancillary services market for balancing and other services provision. It should be noted that with the single imbalance pricing system, which is the default for pricing in the EBGL, there is no financial difference for BRPs in a self-dispatching model whether there is only one or two final positions and consequently for case of financial results there is no need to make any distinction. Also in a central-dispatching model with a single imbalance pricing system, there would be no financial difference for BRPs in cases where it has one, two or even several scheduling units with separate final positions per imbalance area, provided that these scheduling units are located in the same imbalance price area. Put differently, imbalances compensation of different scheduling units would not be made through "volume effect" but through the uniform "price effect".

It should also be noted that the locational information about generation and load distribution in the grid is important for TSOs from a security of supply point of view, but out of scope of the EBGL as far as the self-dispatching model is concerned with respect to imbalance settlement. The guideline on electricity transmission system operation ("SOGL") deals with the organisation, roles and responsibility of physical schedules exchange that are outside the scope of the EBGL for self-dispatching models, so there is no need to mention them in the proposal for position harmonisation. Instead, as this separation of the responsibility for reporting on physical schedules from the imbalance settlement process is a major change for some TSOs and may impact on how the quality on production and consumption schedules are ensured, this separation should therefore be duly considered when drafting the agreements between TSO and BRPs.

For central dispatching models, locational information over scheduling units distribution in the grid is important for TSOs from a security of supply point of view and the EBGL explicitly recognizes this just

allowing the possibility of several final positions at the scheduling unit level per BRP per imbalance area. In central dispatching models indeed the TSO determines scheduling units' commitment and dispatch through direct instructions within an integrated scheduling process that uses integrated scheduling process bids containing as input not only commercial data, but also complex technical data of individual scheduling units including their locational distribution in the grid and the latest control area adequacy analysis and the operational security limits which take into account locational grid constraints.

The allocated volume is specified by the all TSO proposal to be calculated from the data provided to that purpose as a netted volume of energy volumes physically injected or withdrawn from the system and attributed to a BRP in self-dispatching model or scheduling unit in central dispatching model.. Volumes can be determined as metered volumes per ISP as the result of the metering process (components a and b) or as assigned volumes per ISP (component c) in case that injections and withdrawals are not metered with granularity of ISP. Examples of injections and withdrawals that are not metered with granularity of ISP are injections or withdrawals that are metered with lesser granularity or no granularity (non-smart household meters), for which profiling is used. Another example is gridlosses, which are calculated and not directly metered.

There is no intention in the ISHP to change the current flows of information.

The inclusion of a correction to the allocated volume (component d) is due to national terms and conditions for demand side response that allow independent aggregators to operate demand side response actions, in day ahead, intraday and balancing, on consumption sites without the consent of the site's BRP.

In this model (described in ENTSO-E position on market design for demand side response), there is a need to adjust the BRP's allocated volume so that it is not financially impacted by the third party's activity. This adjustment needs to be included in the allocated volume calculation. In certain jurisdiction it is or will be possible to become an 'independent (third party) aggregator' of various flexible energy resources. These third parties aggregate portfolios of small resource for the purpose of meeting thresholds for products required by the TSO (e.g. balancing services). The resources are typically located behind the boundary point of a location, for which the third party is not responsible. These independent aggregators can be active on balancing markets (as a BSP) or on day-ahead or intra-day markets. However, independently of being or not a BRP, the third parties can be set responsible for imbalances from over or under delivery of the product, in the same conditions as a BRP, and therefore this is compliant with article 18(6) of EBGL, without applying all BRP framework to those specific market players.'

The inclusion of a correction to the allocated volume (compoment e) for residual energies is due to national terms and conditions, that may require to allocate residual energies that may result from allocating components a, b, and c and volumes that are that are not metered per ISP (e.g. non-smart household meters) or not metered at all (e.g. energy theft)

This proposal's Article 4 ensures the obligation of the TSO to inform the BRP on the allocated volumes and the calculated imbalance, and thus the right of the BRP to be informed, thus contributing to a level playing field for all BRPs. When developing the proposal for imbalance price harmonisation, differences between the imbalance settlement practices among the TSOs were surveyed (see annexes C & D) and found to vary amongst the TSOs. The finalisation time of the initial settlement and the billing date for the imbalances are important features from the BRP's point of view, as it may affect the BRP's cashflow. EBGL is not requiring harmonisation for the finalisation time of imbalance settlement and as the changes for finalisation time would probably need changes with the data delivery deadlines with DSO, the current time schedule for harmonisation of imbalance settlement set by EBGL might be too tight and the all TSO ISHP is not harmonising the finalisation times. It should be noted that in the future it would be beneficial to have a harmonised maximum period and different possibilities for it should be analysed.

## Particular implementation

TSOs using a self-dispatching model currently applying the single position per balancing responsible party pursuant EBGL Art. 54(3)(a) for calculating the imbalance of a BRP will continue with the current practice. TSOs currently applying the calculation of two imbalances per balancing responsible party shall change their position calculation by implementing the use of single position.

The implementation of single position should be done no later than eighteen months after approval by all relevant regulatory authority in accordance with Article 5(2) of the EBGL. For the TSOs that need to change to single imbalance pricing and single position, change require changes in their and stakeholders IT systems. It should be noted, that for some TSOs there is also IT changes needed due the change to the 15 min ISP. Linking the single position implementation with single imbalance pricing gives a practical benefit to implement these changes at the same time (e.g. IT system changes can be done at the same time). It is up to the national TSOs and NRAs to adapt to the target model efficiently.

The change to the single position shall be implemented by requesting amendments in order to make terms and conditions developed in accordance with the EBGL Article 18 and consistent with the EBGL Article 54(3)(a). The request for amendments shall be done following the approach pursuant to the EBGL Article 6(3) on a national level.

TSOs applying central dispatching model shall continue calculating the position pursuant to the EBGL Art. 54(3)(c).

## 2.5. Article 5: Components used for the calculation of the imbalance price

### Applicability

The ISHP for components used for the calculation of the imbalance price applies both for self-dispatching and central dispatching models.

### Legal background

The EBGL Article 52(2)(b) requires a proposal to further specify and harmonise, at least:

*"The main components used for the calculation of the imbalance price for all imbalances pursuant to Article 55 including, where appropriate, the definition of the value of avoided activation of balancing energy from frequency restoration reserves or replacement reserves."*

The EBGL Article 44(2) requires:

*"Each relevant regulatory authority in accordance with Article 37 of Directive 2009/72/EC shall ensure that all TSOs under its competence do not incur economic gains or losses with regard to the financial outcome of the settlement pursuant to Chapters 2, 3 and 4 of this Title, over the regulatory period as defined by the relevant regulatory authority, and shall ensure that any positive or negative financial outcome as a result of the settlement pursuant to Chapters 2, 3 and 4 of this Title shall be passed on to network users in accordance with the applicable national rules."*

The Article 5 of ISHP exhaustively lists all the components that may be used for imbalance price formation in the target model. The paragraph 2 lists the main components, to be taken into account by all TSOs for imbalance price calculation and thus is answering the EBGL Article 52(2)(b) requirement. The paragraph 3 lists the volumes that may be used in the imbalance price calculation or indicating the direction of imbalances. The paragraph 4 states the possibility to use estimations of volumes with the intention to allow the calculation of a final imbalance closer to real time, which would not be possible with a very strict reading of paragraph 3. The paragraph 5 lists other possible, non-obligatory additional components that TSO may use by approval of relevant regulatory authority.



The second paragraph of Article 5 provides an exhaustive list of the prices from which each TSO shall choose main components for calculating the imbalance price in a given imbalance price area for an ISP. The wording "shall use one or more" is resulting from the choice, that the imbalance price calculation methodology is left for each TSO and relevant NRA decision. Thus depending on the each chosen methodology, it can be justified to use only one of the prices listed in paragraph 2 but as well it can also be well justified to use more than one of these prices. The prices refer to the demanded and fulfilled volumes of balancing energy of the connecting TSO or connecting TSOs demand. This means e.g. that activation of balancing energy by a connecting TSO only to fulfill the balancing energy demand of another (requesting) TSO is not taken into account for the imbalance price calculation of connecting TSO, as the demand for balancing energy came from someone else.

The third paragraph provides an exhaustive list of the possible volumes that can be used for each TSO's imbalance price calculation. The wording "if relevant" is a result from possibility of different choices for each TSO's imbalance price calculation methodology: e.g. a TSO not performing the RR process may neglect volumes and prices resulting from the RR process rather than considering balancing energy volumes from RR process to be 0 MWh/ISP. The proposal should be interpreted such that if a volume fulfilling the balancing energy demand is 0 MWh/ISP, the corresponding price will not influence the imbalance price.

The fourth paragraph allows for closer to real time pricing, e.g. by allowing using volume estimates for establishing the direction in which an imbalance of a BRP might help the system to restore its balance.

The fifth paragraph provides an exhaustive list of potential price components that each TSO may incorporate in the calculation of the imbalance price, after approval by its relevant NRA. The components that TSOs foresee as these additional components are scarcity component, incentivizing component to fulfill nationally defined boundary conditions and a component with regard to the financial neutrality of TSO.

As these additional components create a possibility to diverge nationally from using only the main components for imbalance price determination, the TSO that has a regulatory approval to use such components shall according to paragraph 6 publish the value of these additional components. The paragraph 7 is stating that these additional components can be either added or subtracted from the imbalance price that is calculated by using the main components and depending on the methodology, the volume components. This non-symmetric application of additional components may result in dual imbalance pricing, and thus may define a condition for the application of dual imbalance pricing.

The final imbalance price used to settle the BRP imbalances, independent what methodology is chosen by each TSO and what additional components may be used, shall respect the boundary conditions established already in EBGL Art 55(4) and (5).

The EBGL defines "imbalance area" and "imbalance price area", and requires that both an imbalance area and an imbalance price area are to be delineated in each TSOs terms and conditions for BRPs, but only specifies in Article 54(2) the imbalance area as a scheduling area, or in case of central dispatching model, part of a scheduling area. The ISHP in addition further specifies in Paragraph 8 and 9 the imbalance price area, to allow for single TSOs in central dispatching model to have several imbalance price areas if so desired, and to allow multiple TSOs within a single bidding zone, to combine their imbalance areas in one larger imbalance price area.

The following sections presents different alternatives TSOs have identified, regarding the approach to Article 5.

### Alternatives

With Article 5, TSOs needed to make a choice of approach and interpretation of EBGL. The EBGL strictly requires to harmonize and specify the main components used for calculating the imbalance price. The TSOs needed to choose how to approach the imbalance price calculation and possible other components than main ones, as EBGL speaks only about main components.

As an alternative to the current approach of the proposal, TSOs could have mentioned only main components leaving the interpretation open. This would have left the proposal unambiguous and not transparent. Another alternative could have been to make strict list of main component resulting from balancing energy price and propose that any other component cannot be used.

The EBGL is not requiring the methodology, how the imbalance price should be calculated i.e how the component used for imbalance price calculating should be combined to create the single imbalance price. TSOs acknowledge, that EBGL is not forbidding to propose a harmonized common methodology, as EBGL states that “at least” certain features has to be harmonized. In the ISHP, TSOs are not proposing a methodology for imbalance price calculation. An alternative to the chosen approach not to propose a methodology would have been to propose a detailed methodology.

TSOs also needed to do the interpretation, which volumes can be used, if the national methodology requires to use volumes in the imbalance price calculation. The alternatives to the TSOs choice in ISHP to use balancing energy volume demand of TSOs imbalance price area were identified as the locally activated volumes or the energy volumes activated within uncongested area.

Not specifying further the imbalance price area in the ISHP would lead to less transparency for stakeholders and NRAs, especially in case of multiple imbalance areas (= in self-dispatching model scheduling area) within a single bidding zone).

### **Argumentation**

This section discusses the argumentation and rationale behind the TSOs choices made for Article 5 of ISHP.

#### **Choice to include also additional components besides the main components**

ISHP is providing a comprehensive list of components that can be used for the imbalance price calculation. The components are separated in to the main and volume components, which results from the balancing energy from frequency restoration and replacement processes, and to additional components.

The main price components and depending on the each TSO's methodology the volume components provide the base imbalance price, and where relevant the direction of the aggravating imbalance. The main components mentioned in paragraph two, the prices resulting from FRP and RP TSOs need to use and the volume components mentioned in paragraph 3, the TSOs may use depending on their choice of methodology.

The additional components were added in order to increase the transparency that there may be TSOs that wish to use also other components in imbalance price calculation than only the prices and volumes resulting from the balancing processes. The need for other components than the main components can result from the different balancing philosophies among TSOs, from the different internal gate closure time of the earlier markets and the different ways to ensure and interpret the TSOs financial neutrality, which is left for the responsibility of each national regulatory authority.

#### **Choice for the main components in paragraph 2**

As the imbalance price should reflect the real time price of energy, and should provide incentives to the BRP to be in balance or help the system to restore its balance, the logical non-exclusive alternatives for the main component are the energy prices that TSOs are facing as a result of balancing processes inside their control area.

Taking into account exclusively the prices from mFRR, aFRR and RR to the imbalance price calculation follows the minimum requirement for the imbalance price. These are also the prices that in the future will have the harmonised pricing methodology according to Article 30 of EBGL. This harmonised pricing method is required by Whereas 14 to create positive incentives for market participants in keeping/or helping to restore the system balance of their imbalance price area. As this requirement should be guaranteed by the balancing pricing method to be developed pursuant Art 30 in EBGL, it is well justified that these prices are brought to the imbalance price.



As the imbalance price is linked to the balancing prices for FRR and RR, it should be noted that there is ongoing development of common European balancing platforms pursuant to EBGL Articles 19, 20 and 21. The balancing price will be determined in these platforms in the future and the pricing for these balancing products is out of scope of the imbalance price calculation. However, the following assumptions are made based on the requirement of Article 30 and the current development of the balancing platforms:

- The activation of balancing energy is not as default local. With the common balancing platforms, when there is free capacity, the TSO A's need can be fulfilled by activation from TSO B's control area.
- The balancing energy pricing is assumed to be based on cross-border marginal pricing.
- The implicit netting will in future be part of the balancing platforms developed according the Articles 19, 20 and 21.

These assumptions made above indicates that the balancing energy can be activated also in other areas than the TSO's own control area. Balancing energy is activated in the area of connecting TSO and imported to the TSO with the balancing energy demand. The balancing energy demand shall be understood as a demand that TSO is sending and requesting from the future platforms, and in case of specific local products, the demand that TSO request from the local BSP. Thus the balancing needs of the TSO may also be fulfilled by exchange of balancing energy between TSOs. This exchange of energy is noted in EBGL as intended exchange of energy from the reserve replacement process or from the frequency restoration process with manual or automatic activation. By the EBGL Article 50(6) the settlement rules for the intended exchange of energy should take into account the balancing prices of FRR and RR. Thus the requesting TSO can use the intended exchange to balance its imbalance areas, and the prices should take into account the balancing prices. So the price for the intended exchange is assumed to be taken into account in the price for volume of balancing energy demand and thus there is no need to mention explicitly the price for intended exchange.

### **Choice for the volume components in paragraph 3**

Volumes to be taken into account in determination of imbalance price serve particular two purposes: in case of volume weighted average price, where volumes are used in the calculation method; and in case of marginal price, when a 0 MWh volume removes the corresponding price from the list from which a marginal price is determined for a given imbalance price area. The second purpose for using volumes is establishing the direction in which an imbalance of a BRP might help the system to restore its balance for a given imbalance price area.

The volumes are based on fulfilling the TSO or joint TSOs demand of balancing energy in a given imbalance price area.

In the imbalance price calculation TSO may need to know which activated energy volumes should be used to indicate the volumes that shows what part of the balancing was used for TSO's need. When balancing is done only locally, it is more straightforward to determine, that all activated balancing energy inside the imbalance area was for the local need. In case of only local balancing, the TSO has at the same time the role of requesting and connecting TSO and thus the balancing energy activated is used by the same TSO. In this case, the balancing energy price also reflects the local imbalance situation.

In the future pursuant to development of common European balancing platforms the balancing energy may be activated in one TSO's area for the need of another. This means that the requesting and connecting TSOs can be different ones. Also as the balancing is done in a larger market area than the local imbalance area, the balancing price reflects the activations needed for whole area where activations can be done instead of the local imbalance area. This brings an inconsistency, if imbalance price is wanted to reflect the local imbalances, as the balancing price is a main component of imbalance price. The choice, whether to let the imbalance price reflect the imbalance situation of the same area that the balancing price is reflecting or if the effect of balancing price is wanted to be mitigated to reflect a bit better the local imbalance situation, it can be done by determining which volumes are taken into account when determining the imbalance price.

There is no explicit requirement for TSOs to harmonise this issue and EBGL is not clear to what volumes it refers in the Article 55 for energy activated for calculation of the minimum requirement. However it should be noted, that there are several options how the volumes to calculate the minimum requirement could be chosen in terms of the processes, type of the product and how the activation takes place from the common merit order lists of the balancing platforms developed in accordance with EBGL Art 19, Art 20 and Art 21.

The detected mutually exclusive options to consider which volumes are possible to consider in imbalance price calculation are:

- **The fulfilled volume of balancing energy demand**

This option refers to the need for balancing volume requested by TSO for its imbalance price area and further fulfilled by standard or specific products. In context with the development of the European balancing platforms, the TSO demands requested are fulfilled by the clearing process resulting from the common merit order list. In case of the netting processes already integrated to the balancing platforms, this choice would also include the requests that are fulfilled by the intended exchange of energy from the respective platform. This choice would also mean that the balancing price effect is mitigated to reflect better the local imbalance situation for TSOs as each TSO have their own total amount of fulfilled needs.

- **Locally activated volumes**

This option refers to the bids selected by the clearing process and activated within the imbalance price area. For the areas where balancing is done locally, this solution would be reflecting the local imbalance. In common balancing markets, this choice would not be feasible one, as it does not tell anything about the actual imbalances inside imbalance area, as the activated energy inside the imbalance area can be carried out for other TSOs need. This option is not seen feasible in the future with the common balancing platforms.

- **Activated volumes within uncongested area**

If for the common balancing platforms the cross-border marginal price is applied, it means that the balancing price is reflecting the balancing need of that uncongested area. If the imbalance settlement is seen as a part of balancing market and not as a separate mechanism, it could be argued that the imbalance price and balancing prices should be reflecting the imbalance situation and activated energy price from the same area. However, this choice would not tell about the imbalance of the local imbalance area, but instead about the imbalance of a possibly larger area, where the balancing price is formed.

This approach is following similar principles as the day-ahead and intraday market coupling.

The ISHP refers to the volumes of fulfilling the balancing energy demand of the TSO (or connecting TSOs) of an imbalance price area, as this reflects better the imbalances of the imbalance price area.

While both the imbalance area and imbalance price area are defined in the EBGL only the imbalance area is specified in EBGL, as equal to a scheduling area, or in case of central dispatching model part of a scheduling area. The ISHP specifies the imbalance price area as one or more imbalance areas, thus allowing bidding zones with several imbalance areas to have a uniform imbalance price across the combined imbalance areas.

Volumes are also to be used to establish the direction for a given imbalance price area. The mentioned volumes per direction and product, fulfilling the balancing energy demand for FRR process and RR process of the imbalance price area and for the ISP, the volumes per direction fulfilling the balancing energy demand by the IN process and the volumes per direction of unintended exchanges of energy are elements or measures for balancing the system. If all those volumes are summed up per direction, the direction for the imbalance price area can be established. The direction determines which imbalances of BRPs are aggravating and which imbalances of BRPs are non-aggravating imbalances. In case of application of dual imbalance pricing, non-aggravating imbalances may according to Article 8 (2)(b) ISHP be priced according to Article 5 ISHP or

according to the value of avoided activation according to Article 6 ISHP, while aggravating imbalances have to be priced according to Article 5 ISHP. Article 5 and Article 6 ISHP in accordance with EBGL do not allow inclusion of volumes fulfilling the balancing energy demand by the imbalance netting process or volumes of unintended exchanges of energy in price calculation.

### **Choice for additional components in paragraph 5**

The ISHP lists also other components than main components that can be used in imbalance price calculation with the approval of the relevant regulatory authority. These additional components are scarcity component, incentivizing component to be used to fulfill nationally defined boundary conditions and the component with regard to financial neutrality of the connecting TSO pursuant Article 44(2) of the EBGL. For the ISPs where additional components are applied the value of these additional components will be published by the TSO, in addition to the requirement of Transparency Regulation 543/2013 Article 17(1)(g) to publish the imbalance prices.

The rationale to include the mentioned additional components in ISHP is explained below:

#### **Scarcity component**

A scarcity component is an additional component, that may be added to or subtracted from the imbalance price. So the imbalance price will be calculated / determined according to Art 5 (2) and possibly paragraph (3) of ISHP in the first step – in a second step, the scarcity component will be applied. A scarcity component will only be applied in ISP with scarcity situation in the local system in order to assure an imbalance price reflecting the local system scarcity situation. The definition of scarcity situation also needs to be approved by local NRA.

The imbalance price can be seen as a price that reflects the real-time value of energy, in scarcity situations the use of scarcity adder in imbalance price could be seen as reflecting the real-time value of consequences of load shedding. In case when there is a scarcity situation, there might be a need to give a signal for market participants of the current state. Such a signal needs to be communicated to market participants in relevant time, e.g. in advance or in (close to), in real time.

It should be noted that when a scarcity component is applied only to the imbalance price, it will decouple imbalance price from balancing energy prices and that will affect the value of imbalance adjustment in relation to the imbalance value itself. It should also be noted that when a scarcity adder is applied to the imbalance price, it will create a financial surplus for TSO. Designing and applying such a component shall be a national choice and is left under consideration of national NRA and the NRA is responsible to guarantee the financial neutrality of TSO pursuant Article 44(2).

#### **Incentivising component to be used to fulfill nationally defined boundary conditions**

All TSO proposal article 5(5) includes the possibility to use the incentivising component in case the TSO identifies a need for incentivizing market participants to attempt to close their positions on earlier markets rather than leaving it for imbalance settlement.

A TSO may decide to implement an imbalance pricing scheme that takes into account liquid local, shortterm wholesale market prices (e.g. Intraday-prices in this market area or Day-Ahead where Intraday is not sufficiently liquid). A TSO may for example propose to the local NRA an incentivizing component where there are local intraday markets with a Gate Closure Time after Balancing Energy Gate Closure Time of the common Balancing Platforms. In that way, gambling on arbitrage between the wholesale market and imbalance prices should not be possible. An incentivizing component, that may for example represent the price spread between imbalance and Intraday market prices, sets an additional boundary condition that the imbalance price shall be at least the price of the defined wholesale market price.

An incentivizing component is strengthening the price signals of, for example, the local Intraday Market representing the real time value of energy. If the imbalance price scheme ensures, that the imbalance price is at least as high as the price / a price index of the local, for example, Intraday Market, market participants are

incentivized to close open positions on the whole sale market. This increases the market volume of those Markets, ensures to reflect imbalance prices the local real time value of energy which gives the crucial incentive for market participants to balance their portfolio locally, ensures a higher level of system security, as TSO action is needed only for unforeseeable imbalances. Therefore TSOs need less balancing energy, have free resources for scarcity situations and in the long run are able to procure less balancing capacity and therefore may be able to reduce grid tariffs where they carry balancing costs. Furthermore scarcity situations are better reflected, as balancing energy prices of the pre-contracted balancing energy bids may be much smaller than prices at the Intraday Market.

Using additional components in imbalance pricing does not introduce any globally applicable boundary conditions other than the one set by the EBGL Art 55. An additional incentivizing component may be designed to function effectively as an additional boundary condition, with the difference that it is only applicable in those countries where designed to be part of the specific imbalance price model, proposed to and approved by the local NRA.

It should be noted that when the incentivizing component is applied to the imbalance price, it will decouple imbalance price from balancing energy prices. Within the ISPs in which an incentivizing component is applied to imbalance price, it will create additional income for the TSO – such additional income shall not stay with the TSO pursuant to the EBGL, Art 44 (2).

All-TSO proposal article 5(5) includes the possibility to use the incentivizing component in case the TSO identifies a need for incentives to BRPs to keep balanced. Designing and applying such a component shall be a national choice and is left under consideration of each NRA.

#### **A component with regard to the financial neutrality of the connecting TSO pursuant Article 44(2) of the EBGL**

As the financial neutrality is not harmonised but instead left for the responsibility of each NRA, there might be need to use additional components with regard to the financial neutrality of the TSO.

#### **Choice not to include the methodology in the proposal**

The ISHP does not include any proposal for harmonized methodology for calculating the imbalance price. It is acknowledged that similar pricing dynamics and rules for calculating the imbalance price would be a step further with harmonizing and integrating the balancing markets. However at the same time it needs to be understood, that the operational balancing is a national responsibility and TSOs have the right to choose their balancing philosophy, which may have effects how their imbalance price need to be defined.

Due the different practices and views in operational balancing the imbalance pricing methodology may be justified to be different. To evaluate the best methodology can depend for example on the how many products a TSO uses for balancing, does a TSO want BRPs to only keep their balance or also support the system, and also possible national requirements on validating the amount of balancing energy delivered by the BSPs, as the imbalance price that deviates from the balancing price causes different incentives for BSPs to deliver the balancing energy through the imbalance adjustment.

As already stated in the Section 1.1. of this document, there is little or no common or operational experience of all the upcoming future changes. So TSOs consider that the ISHP should not prematurely lock the details of imbalance pricing. To give now a single comprehensive methodology would also be risky, as many TSOs do not have the experience with the cross-border balancing neither how the cross-border balancing market can influence the incentives of BRPs and BSPs.

Even with no explicit proposal for a methodology, there is still the minimum boundary conditions for the imbalance price that are set by the EBGL Article 55 (4) and (5) that already guarantees the harmonized boundaries for the imbalance price calculation. For the better understanding, this document is providing in Appendix E examples of the possible methodologies that could be applied.

## 2.6. Article 6: Definition of the value of avoided activation of balancing energy from frequency restoration reserves or replacement reserves

### Applicability

The proposal for the definition of the value of avoided activation (VoAA) of balancing energy from frequency restoration reserves or replacement reserves ('the value') applies to both self-dispatch and central dispatching models. There are two options: one for single imbalance pricing; and one for dual imbalance pricing models.

### Legal background

The EBGL Article 52(2)(b) requires a proposal to further specify and harmonise at least:

*"The main components used for the calculation of imbalance price for all imbalances pursuant to Article 55 including, where appropriate, the definition of the value of avoided activation of balancing energy from frequency restoration reserves or replacement reserves".*

The EBGL Articles 55 (4)(b) and 55(5)(b) set out when the value of avoided activation of balancing energy from frequency restoration reserves or replacement reserves is used.

The EBGL Article 55 (4)(b) requires that:

*'The imbalance price for negative imbalance shall not be less than....  
(b) in the event that no activation of balancing energy in either direction has occurred during the imbalance settlement period, the value of avoided activation of balancing energy from frequency restoration reserves or replacement reserves'.*

The EBGL Article 55 (5)(b) requires that:

*'The imbalance price for positive imbalance shall not be greater than [...] (b) in the event that no activation of balancing energy in either direction has occurred during the imbalance settlement period, the value of avoided activation of balancing energy from frequency restoration reserves or replacement reserves'*

The EBGL Article 44 (1) requires that:

*The settlement processes shall:*

- (a) establish adequate economic signals which reflect the imbalance situation;*
- (b) ensure that imbalances are settled at a price that reflects the real time value of energy;*
- (c) provide incentives to BRPs to be in balance or help the system to restore its balance;*
- (d) facilitate harmonisation of imbalance settlement mechanisms;*

### Alternatives

The value of avoided activation may serve as reference price when there are no activations of balancing energy in either direction for the imbalance price area, or as the imbalance price for non-aggravating imbalance in case of application of dual imbalance pricing in accordance with Article 8(1)(a) of the ISHP. There are actual situations in which this might happen in an imbalance price area:

- a) when the imbalance price area is in balance;
- b) when the imbalance price area is not initially in balance but the TSO has only used imbalance netting with neighbouring TSO(s) to bring it back into balance;
- c) when the connecting TSO fails to establish a balancing energy demand,.

These instances may be extremely rare, yet have the common property that they can occur any ISP.

There are several options to determine imbalance price in these cases, to establish a value of avoided activation as reference price (See Appendix C):



- a) Regulated fixed price
- b) Persistency – where the price for an ISP is set to be equal to that of the preceding ISP
- d) Day-ahead price
- e) Intraday price
- f) Merit order lists

### Argumentation

TSOs have rejected options (a) to (d) on the basis that they have no regulated fixed price or a limited relationship to actual balancing market conditions required by the EBGL Article 44(1)(a) and 44(1)(b), thus not truly reflecting the VoAA in an imbalance settlement period. Therefore, option (e) (merit order lists) is left as the best option to meet the requirements of Article 44(1).

The approach to the VoAA is consistent with the approach for imbalance price in Article 5 of the ISHP. The prices that should be used to calculate the value of avoided activation are specified, but not how they should be used to give the value.

The calculation of the VoAA uses the same components as Article 5 of the ISHP. The only difference is that the components in Article 5 are based on the actual activations of energy made by the TSO, whereas for VoAA there are no activations. The price components for VoAA are those available to the TSO but not activated. As an example, the TSO may choose to specify the VoAA as the average of the 'cheapest' bids available to it in the upwards and downwards directions.

In an efficient balancing market, the VoAA serves as a default (reference) imbalance price, giving all BRPs equal knowledge on what to expect. In an efficient balancing market, settlement of balancing energy comes at societal loss.

For a given imbalance area and ISP, the difference between the actual imbalance price and the VoAA determines how incentivised BRPs are to minimise their imbalance. Relating the VoAA to the MOL better links it to the real-time value of energy, and creates a more accurate reference point for BRPs.

The EBGL Article 52(2)(d) requires a definition of conditions and methodology for applying dual imbalance pricing for all imbalances. If a TSO is using dual imbalance prices, in the event of no activations taking place they may require two values of VoAA. One to give a reference imbalance price for shortage, and one for surplus. However, the TSO can set a single value of avoided activation by setting the two values as equal. Depending on the methodology for the VoAA, there may be one or two VoAA calculated (eg. Midprice, e.g. first bid of the MOL of each direction) and subsequently can be used in case of application of dual imbalance pricing according to Article 8 (1) and (2).

### Particular implementation

The implementation of the value of avoided activation shall be a prerequisite for implementation of Article 5 in the ISHP on main components of the imbalance price.

## 2.7. Article 7: The use of single imbalance pricing

### Legal Proposal

Each TSO shall implement the use of single imbalance pricing in accordance with Article 55 of the EBGL for all imbalances.

### Applicability

The proposal for the use of single imbalance pricing applies to self-dispatching models and central dispatching models.

## Legal background

In accordance with EBGL Article 52 (2) (c) the use of single imbalance pricing is prescribed for all imbalances, thus defining the target model.

However, Article 55(2)(d)(i) of the EBGL asserts the right of each TSO to propose to its relevant NRA the conditions and methodology to apply dual imbalance pricing.

## Alternatives

The alternative to single imbalance pricing is dual imbalance pricing. The conditions and methodology for applying dual imbalance pricing are proposed in the all TSO proposal Article 8.

## 2.8. Article 8: Definition of conditions and methodology for applying dual imbalance pricing

### Applicability

The EBGL Article 52(2)(d)(i) states that the conditions to apply dual imbalance pricing may be proposed by a TSO to its relevant regulatory authority. The proposal is therefore only applicable to the imbalance pricing if the TSO chooses to do so and after a regulatory authority approval.

The EBGL Article 52(4) states that “*The proposal pursuant to paragraph 2 shall provide an implementation date no later than eighteen months after approval by all relevant regulatory authorities in accordance with Article 5(2) “.*

The EBGL Article 55(3) states that each TSO shall determine the imbalance price for (a) each ISP and (b) its imbalance price areas. In case of dual imbalance pricing, there will be two prices for a given ISP and a given imbalance price area. Depending on the conditions for which application of dual imbalance pricing is requested this may be for a given imbalance price area for some ISPs or for all ISP. The Transparency Regulation 543/2013 Article 17(1)(g) requires the TSOs to publish imbalance prices, regardless of application of single imbalance pricing or dual imbalance pricing.

The boundary conditions of EBGL Article 55 (4), (5) and (6) for imbalance price calculation apply, regardless of application of dual imbalance price.

### Required justification for proposing dual imbalance pricing

The general objective of imbalance settlement (EBGL) is to ensure that BRPs support the system's balance in an efficient way and to incentivise market participants in keeping and/or helping to restore the system balance. EBGL defines rules on imbalance settlement, ensuring that it is made in a non-discriminatory, fair, objective and transparent basis. To make balancing markets and the overall energy system fit for the integration of increasing shares of variable renewables, imbalance prices should reflect the real-time value of energy.

Based on the general objectives as stated in EBGL, the TSOs applying for dual imbalance pricing shall provide to its relevant NRA a justification that considers at least the following aspects:

- The impact on the financial outcome of the settlement processes (included in EBGL Title V) for the TSO;
- Impact on the incentives for BRPs and related consequences for operational security;
- Non-discriminatory and transparent market design;
- Cross-border market aspects.



### **Condition (a) Dual pricing as a mitigation measure for power oscillations in specific ISPs**

Real-time information feedback loop on system balance state combined with single imbalance pricing may result in a strong self-regulation behavior which in its extension trigger power oscillations in system balance, thus negatively impact on operational security. The power oscillation may occur when the self-regulation response overcompensates for the system imbalance which in turn triggers an opposite self-regulation response.

Real-time information on system balancing state reflects the current need for positive or negative balancing energy. The balancing state may however not reflect local congestions inside a bidding zone why strong self-regulation behavior may be counterproductive and impact on the operational security.

A dual imbalance pricing scheme in specific ISPs where the system operator identifies a operational need to reduce the effects of too strong self-regulation may provide a dampening effect without removing the overall beneficial self-regulation behavior.

Delay publication of real-time information on system balancing state may also be used in combination or as an alternative mitigation measure. EBGL, article 12.3 states that:

Each TSO shall publish the following information as soon as it becomes available:

*(a) information on the current system balance of its scheduling area or scheduling areas, as soon as possible but no later than 30 minutes after real-time; [...]*

Publication of real-time information is however out of scope of ISHP even though the relation between self-regulation behaviour and real-time information is important to take into account when the Power oscillation mitigation measures in the pricing scheme is considered.

#### **Considerations**

Application of dual imbalance pricing in order to dampen the effect of self-regulation will however hamper the incentives for market participants to restore the system balance and benefit from, as well as influence the real-time value of energy. Those aspects should therefore be thoroughly considered and weighed towards the anticipated negative effects on operational security. Application for dual pricing shall for that purpose shall therefore be restrictive and only be used in specific ISPs where the need is evident. Restricted market access to real-time information (i.e. information published with a time shift less than a few minutes) could also be considered in the same context within the legal boundary conditions set out in the EBGL article 12. These considerations are as previously stated out of scope for ISHP.

#### **Consequences if not applied**

This is a condition that each TSO may choose to propose to its NRA based on the above described argumentation and considerations. The condition should only be applied if it can be justified as a necessary mitigation measure for power oscillations, and full harmonisation (applied by all TSOs) should not necessarily be pursued.

The consequences if the condition is not applied by all TSOs are deemed limited due to presumed limited use in specific operational situations and thus in a limited number of ISPs. TSO specific justifications whether to apply or not apply the condition is more important for efficient market functioning than full harmonisation.

### **Condition (b) Where problems in system operation are foreseen as system imbalance does not indicate a clear incentive in individual ISPs**

Cross-border marginal pricing decouples balancing energy prices and therefore imbalance prices from the local system state. The local system state in an ISP may not require support actions by the BSPs while pricing

incentives that result from cross-border marginal price setting may incentivise BSPs to support the system. Especially extreme prices of balancing energy resulting from the common platforms can incentivise uncoordinated action of BRPs and cause problems in system operation. Dual imbalance pricing in ISPs with no clear direction can mitigate this effect and assure secure system operation.

### Considerations

If the net sum of all imbalances in an imbalance area lies within a threshold near a balanced state in the imbalance area, a single price will set an incentive to BSPs to react while it is not justified from the operational security point of view. A dual imbalance pricing within a threshold does set a strong incentive to BSPs to keep in balance and not react to the price signal. The local circumstances and specificities of the market are to be considered when proposing to the local NRA the threshold within which to apply dual imbalance pricing. Each TSO may choose to propose to its NRA the application of dual imbalance pricing for specific ISPs under this condition.

### Consequences

Cross-border marginal pricing price incentives may result in BSPs' actions that do not reflect the local system state. Application of dual imbalance pricing that is transparently communicated to the market participants via the publication of real-time information on system balancing state provides BSPs with the information when to keep in balance. Application of dual imbalance pricing under the above condition assures that the local system state is reflected.

### Consequences if not applied

This is a condition that each TSO may choose to propose to its NRA based on the above described argumentation and considerations. The condition should only be applied if it can be justified and full harmonisation (applied by all TSOs) should not necessarily be pursued.

The consequences if the condition is not applied by all TSOs are deemed limited and TSO specific justifications whether to apply or not apply the condition is more important for efficient market functioning than full harmonization.

### **Condition (c) For all ISPs, if the costs of balancing energy used to balance the system and other costs related to balancing with the exception of balancing capacity costs are to be covered by BRPs causing the imbalances.**

A dual imbalance pricing methodology which implements a method of precise price correction provides the needed spread between the price for negative and positive imbalances which allows fine tuning of the prices and with that the right amount of resources to cover the costs of balancing. The single imbalance pricing method may not provide enough resources or may result in a deficit. Particularly, if there is a significant number of ISPs with occurrence of activation of balancing energy in both directions. The dual imbalance pricing methodology in this case (in all ISPs) also allows a stable environment for BRPs and at the same time creates adequate incentives for BRPs to be balanced. To avoid any doubt, the costs of balancing energy used to balance the system shall exclude the costs of procuring balancing capacity. Financial neutrality of TSO is ensured pursuant to the EBGL, Art 44 (2).

### Considerations

Application of the condition in order to cover the cost of balancing energy used for balancing the system will allow a TSOs to apply dual imbalance pricing, thus hampering the harmonisation process. Nevertheless allow to establish sufficient signals for BRPs to be balanced. Imbalance settlement, including imbalance pricing is however not subject for full harmonisation under EBGL and the negative consequences are therefore limited.

### **Consequences of not applying**

This is a condition which each TSO may choose to propose to its NRA based on the above described argumentation and considerations. The condition should only be applied if it can be justified and full harmonisation (applied by all TSOs) should not necessarily be pursued.

The consequences if the condition is not applied by all TSOs are deemed limited and TSO specific justifications whether to apply or not apply the condition is more important for efficient market functioning than full harmonisation.

If the condition is not applied by a TSO, then the sum of financial income and expenses collected from BRPs may not be sufficient to cover the costs of balancing the system and imbalance settlement might not provide sufficiently strong signals for BRPs to be balanced. .

### **Condition (d) Asymmetric application of price components**

#### **Considerations**

In case TSOs apply price components in accordance with Article 5(3) asymmetrically, for a given ISP of such a component has to be added or subtracted from the imbalance price for shortage or for surplus. The imbalance price for this direction is then unequal from the price for the opposite direction and not confirm the definition of single imbalance pricing. This is a condition which each TSO may choose to propose to its NRA in order to design the application of price components in accordance with Article 5(3) in symmetrical and asymmetrically way.

### **Condition (e) For central dispatching model for all ISPs where the application of single imbalance pricing does not provide correct incentives to scheduling units to respect unit commitment and dispatch instructions issued by a TSO within the integrated scheduling process in order to ensure a secure system operation.**

In a central dispatching model, the application of single imbalance pricing implicitly allows imbalances compensation through a “price effect” between all the scheduling units of a given BRP which are located in a given imbalance price area. This way that given BRP could in principle deviate from unit commitment and dispatch instructions issued by a TSO without any financial impact by means of voluntary positive imbalances for some scheduling units in the imbalance price area and voluntary negative imbalances for other scheduling units in the imbalance price area. If this kind of behaviour is often and deliberately used by BRPs, it can bring unjustified market benefits and can accordingly compromise system security as in central-dispatching model this is strongly impacted by the locational distribution of scheduling units and their imbalances over the grid.

#### **Consideration**

The application of dual imbalance pricing may therefore be necessary if a TSO applying a central dispatching model identify the previous behaviours. In fact dual imbalance pricing gives stronger incentives to all the scheduling units of a given BRP which are located in a given imbalance price area to be balanced, thus respecting unit commitment and dispatch instructions issued by a TSO within the integrated scheduling process.

### **Consequences if not applied**

This is a condition that each TSO applying a central dispatching model may choose to propose to its NRA based on the above described argumentation and considerations. The condition should only be applied if it can be justified on the basis of experience gained by TSO resulting from the behavior of BRPs.

The consequences if the condition is not applied by all TSOs applying a central dispatching model are deemed limited because these operators do not manage neighboring transmission systems and TSO specific justifications whether to apply or not apply the condition is more important for efficient market functioning and system security than full harmonisation.

**Condition (f) For all ISPs, if the number of ISPs with the activation of balancing energy in both positive and negative direction exceeds a threshold over a given period; the threshold shall be proposed by the TSO and approved by the relevant regulatory authority in the each TSO's terms and conditions for BRPs.**

Real-time information feedback loop on system balance state combined with single imbalance pricing may result in a strong self-regulation behaviour which in its extension trigger oscillations in system balance, thus negatively impact on operational security. The oscillation may occur when the self-regulation response overcompensates for the system imbalance which in turn triggers an opposite self-regulation response. Real-time information on system balancing state reflects the current need for positive or negative balancing energy. The balancing state may however not reflect local congestions inside a bidding zone why strong self-regulation behaviour may be counterproductive and impact on the operational security.

A dual imbalance pricing scheme may provide a dampening effect without removing beneficial self-regulation behaviour. Particularly, if the occurrence of activation of balancing energy in both directions within one ISP exceeds threshold approved by the relevant regulatory authority for given period (for example 50% of all ISPs over a chosen period), dual pricing is effectively becoming a prevalent imbalance pricing methodology. The dual imbalance pricing methodology, in this case, allows a stable environment for BRPs and at the same time creates adequate incentives for BRPs to strive to be balanced. Additionally, dual imbalance pricing also provide resources to cover the costs of balancing. Financial neutrality of TSO is ensured pursuant to the EBGL, Art 44 (2).

#### **Consequences if not applied**

This is a condition that each TSO may choose to propose to its NRA based on the above described argumentation and considerations. The condition should only be applied if it can be justified and full harmonisation (applied by all TSOs) should not necessarily be pursued.

The consequences if the condition is not applied by all TSOs are deemed limited and TSO specific justifications whether to apply or not apply the condition is more important for efficient market functioning than full harmonisation.

#### **Calculation methodology of the dual imbalance price**

EBGL Article 52(2)(d)(ii) requires a methodology for dual pricing. The proposed methodology is set out in Article 8(2), and is defined on a general level, based on the national methodology for single imbalance pricing in accordance to the components and boundary conditions pursuant to Article 5 in the ISHP.

The rational for the proposed approach is to ensure a close alignment between the single imbalance pricing target model and the dual imbalance pricing methodology. The legal proposal shall thus avoid a separate or diverging approach in case of dual imbalance pricing which may cause discrepancies in the pricing during specific (or all) ISPs where a condition for dual pricing is applied. The Article 5 leaves some discretion for each TSO to further specify the calculation of the imbalance price, which then is reused in the methodology for dual imbalance pricing.

The proposed methodology accommodates for the use of the value of avoided activation as a reference price in case of non-aggravating imbalances.

## Abbreviations

The following abbreviations have been employed in this document:

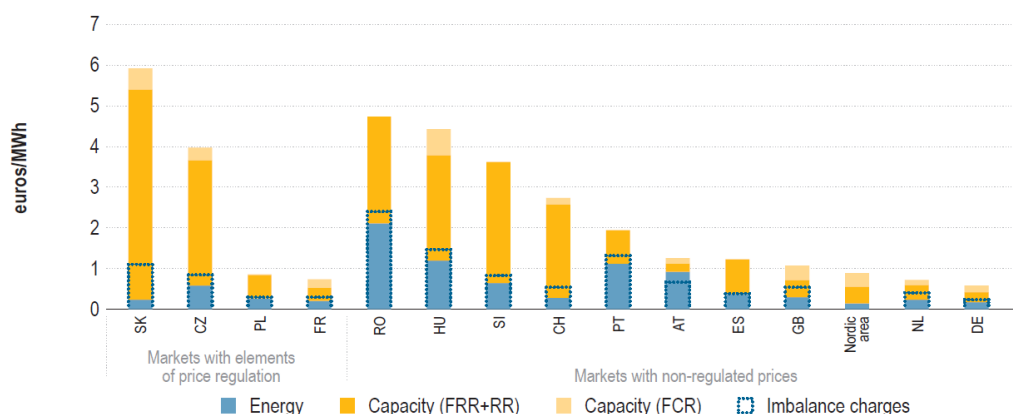
ISHP	Imbalance Settlement Harmonisation Proposal
EBGL	Electricity Balancing GuideLine
BRP	Balancing Responsible Party
TSO	Transmission System Operator
DSO	Distribution System Operator
NRA	National Regulatory Authority
ISP	Imbalance Settlement Period
aFRR	Automated Frequency Restoration Reserves
HVDC	High Voltage Direct Current

## Appendices

### A. Estimation of imbalance charges

The ACER market monitoring report over 2016 the contribution of imbalance charges was calculated in a significant sample of ENTSO-E countries to be around 1 €/MWh per MWh consumed. With total consumption in all ENTSO-region at about 3600 TWh/a, this accounts for an annual value of approximately  $3.6 \cdot 10^9$  €

**Figure 1 - Overall costs of balancing (capacity and energy) and imbalance prices over national electricity demand in a selection of European markets - 2016 (€/MWh) - from ACER Market Monitoring Report 2016.**



Source: Data provided by NRAs through the EW template (2017) and ACER calculations.

Note 1: The overall costs of balancing are calculated as the procurement costs of balancing capacity and the costs of activating balancing energy (based on activated energy volumes and the unit cost of activating balancing energy from the applicable type of reserve). For the purposes of this calculation, the unit cost of activating balancing energy is defined as the difference between the balancing energy price of the relevant product and the DA market price. Imbalance charges applied in the Nordic market are not included in the figure, as data were not available for all Nordic countries.

Note 2: The procurement costs of reserves reported by the Polish TSO comprise only a share of the overall costs of reserves in the Polish electricity system. This is due to the application of central dispatch in Poland, which makes it difficult to disentangle the balancing and redispatching costs.

## B. Harmonised elements of balancing market arrangements in accordance with the EBGL

Definition/Methodology	Harmonised	Localized	Remarks
Standard product FRR, RR	X		
Specific product FRR, RR		X	
TSO Demand RR		X	
TSO Demand mFRR		X	
TSO Demand aFRR	X		Principles in SOGL
Balancing energy volume		X	
Balancing energy price per direction*	X		Number of prices: RR: 0 or 1; FR: 0, 1 or more
Balancing energy specific product		X	
Imbalance volume	X		
position	X		
adjustment		X	depends on balancing energy volume
allocated volume	X		
Neutralization TSO		X	NRA responsibility
Imbalance price per direction*		X	Number of prices 1, default single, main components
* for a given imbalance area, for a given ISP			



### **C. Survey Outcomes on Value of Avoided Activation of Balancing Energy**

- In 17 countries, the default value of avoided activation of balancing energy is the corresponding day ahead or intraday market price; in 2 of these countries as a function of those prices.
- In 4 countries, regulated fixed price is used.
- In 2 countries, persistency is applied (last hour, average over a month).

### **D. Survey Outcomes on Finalisation of Volume Data**

For imbalance a wide range of finalisation moments are reported.

- Shortest within 14 days of day of delivery (6 countries).
- Longest after more than one year (may include reconciliation process with supplier role though).

An additional 14 countries finalise imbalance volume within 3 months after month of day of delivery (taking comments into account).

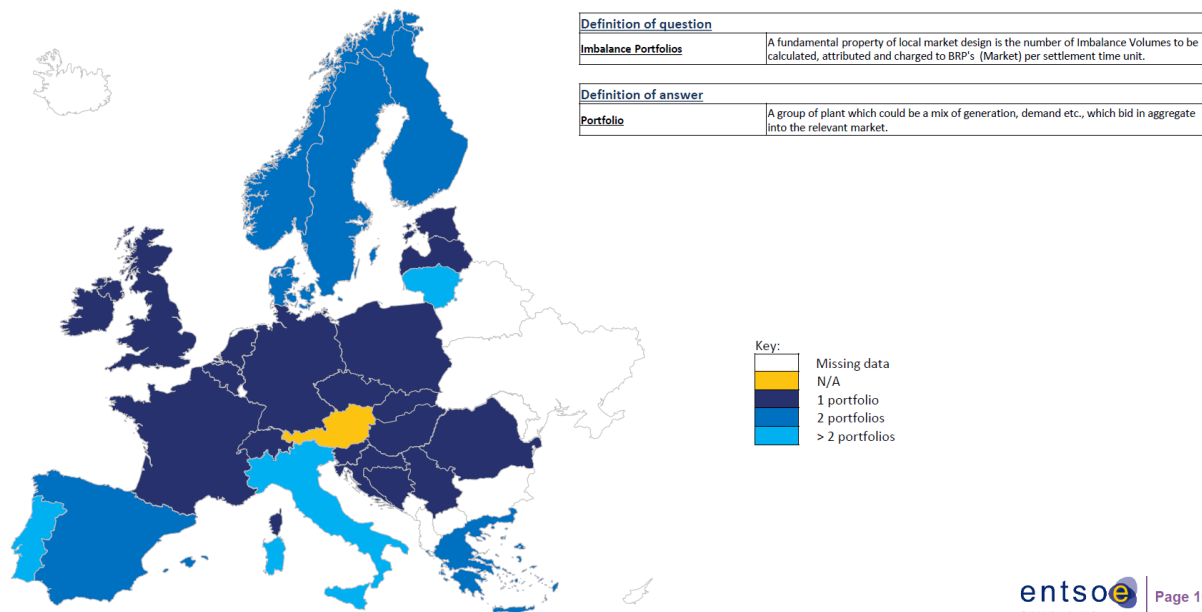
Some answers suggest finalisation over billing period (month) rather than per day-of-delivery. For balancing energy processes finalisation time is equal or shorter.

In about half of the countries, all FRR and RR as requested values. In the other half metered (measured) values for at least part of volumes aFRR and/or mFRR.

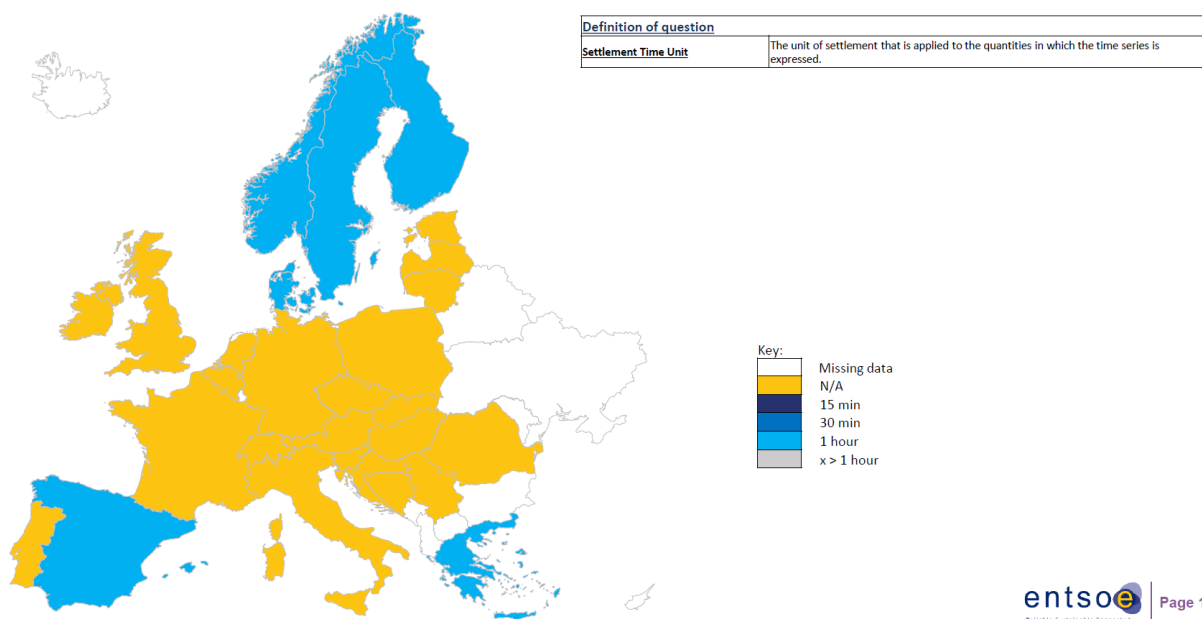
- 1 country will change to requested next year
- aFRR not applicable to 5 responding countries

(In 17 countries, with FCR not determined)

**Figure 2 Imbalance Settlement - Number of Imbalance Portfolios - from WGAS Survey**



**Figure 3 - Imbalance Settlement - Settlement Time Unit (if 2 volumes; generation) - from WGAS Survey**



## E. Examples of the possible methodologies on how to use components to form an imbalance price

The EBGL does not require a harmonized methodology describing how the imbalance price components should be merged in one single imbalance price and for reasons explained in the explanatory document, TSOs are not proposing inclusion of such a methodology in the ISHP. Instead the imbalance price determination and thus also the methodology is left for the discretion of each TSO and is subject for relevant NRA approval.

The possibilities on how to calculate the imbalance price is however limited by the components used for the imbalance price listed in the ISHP and by the boundary conditions set out in EBGL, Article 55(4) and 55(5). The section below presents different possible options identified for the methodology to calculate the imbalance price.

The section below serves for illustrative purposes only and should not restrict or limit the other possible choices of methodology.

## **Two main principles for calculating the imbalance price**

There are two main methodologies for the calculation for the imbalance price are identified:

- **Volume weighted average pricing (VWAP)**, where the balancing energy prices determined according the proposal pursuant EBGL Art 30(1) are merged to single imbalance price by weighting the productwise established balancing energy prices by the volume of productwise balancing energy demand of the TSO for its imbalance price area.
- **Marginal pricing (MP)**, which means choosing the marginal of all established balancing prices pursuant EBGL Art 30(1) of the imbalance price area. This will produce a single price per direction per balancing product.

The balancing price is assumed to be established separately for each product, i.e. there will be balancing energy prices calculated in mFRR platform, aFRR platform and RR platform. The balancing price in these platforms is assumed to be cross-border marginal price (CBMP). As the specific products are also mentioned in the Article 5 of the ISHP, also balancing price for specific products is taken into account as it's own product. The details of the proposed way to establish the balancing prices can be found from the all TSOs' proposal on methodologies for pricing balancing energy and cross-zonal capacity used for the exchange of balancing energy or operating the imbalance netting process. .

In Section 3 these two methodologies, VWAP and MP are developed with presenting the general formula for imbalance price calculation followed with different case examples.

In the examples, the assumed development of the European balancing platforms with cross-border activation of reserves and netting is taken into account and the TSO balancing energy demand can be fulfilled by the intended exchange that is result of the FRR or RR activation or the implicit netting of the platforms.

In case the imbalance price area is balanced by the activation of only one product and thus there is only one balancing price established for the imbalance area, the imbalance price of ISP will be the same despite the chosen methodology, as weighted average price of only one product will be the price of the product itself.

## **aFRR price adjusted to present 15 minutes ISP**

Before merging several balancing prices into a single imbalance price, there is a need to deal with the assumed several aFRR balancing prices, in case the balancing energy pricing period (BEPP) is chosen to be equal to control cycle time which will result in several balancing energy prices per ISP. In case the BEPP for aFRR are different than the ISP (assumed to be 15 minutes), it would be convenient that these aFRR prices can be adjusted to represent single aFRR price component for the one ISP. For illustration purposes, we assume the control cycle to be equal to 4 seconds, which means 225 aFRR CBMP prices per ISP.

Already with the adjustment of several aFRR balancing energy prices to reflect the price component for single ISP, it can be chosen, whether to use the VWAP or MP of all prices that have occurred within one ISP. During the ISP TSOs demand for aFRR balancing energy can be for both directions, which means that in case of single imbalance pricing the boundary conditions of EBGL Article 55(4) and (5) has to be respected, i.e. the average has to be taken separately over prices of negative balancing energy and positive balancing energy.

**Using VWAP the aFRR price component for one ISP could be calculated as following:**

One aFRR cycle has 225 prices, which are denoted as  $P_i, i = 1, 2, \dots, 225$ . The aFRR volumes for which the prices are allocated are denoted as  $V_i, i = 1, 2, \dots, 225$ .

The average of all of these balancing energy prices for one ISP could simple be calculated as

$$\frac{\sum (P_i V_i)}{\sum V_i}, (1)$$

but in case there has been prices for both negative and positive balancing energy, the boundary conditions of EBGL Art 55(4) would be violated, and thus the formula 1 is not appropriate and the volume weighted average needs to be calculated separately per direction.

In case single control cycle aFRR price  $P_i$  is set by selected positive balancing energy bid  $i$ , it is denoted as energy price  $P_{iup}$  and it's volume is denoted as  $V_{iup}$ . Now to respect the condition of EBGL Article 55(4)(a) the average price of positive activated aFRR energy prices for the ISP is calculated by

$$\frac{\sum (P_{iup} V_{iup})}{\sum V_{iup}}, (2)$$

In case single control cycle aFRR price  $P_i$  is set by selected negative balancing energy bid  $i$ , it is denoted as energy price  $P_{idown}$  and it's volume is denoted as  $V_{idown}$ . Now to respect the condition 55(4)(b) the average price for negative activated aFRR energy price for the ISP is calculated by

$$\frac{\sum (P_{idown} V_{idown})}{\sum V_{idown}}, (3)$$

A numerical example how the weighted average price can be calculated from the different aFRR prices established for one ISP is presented below. The table 1 lists the values used in calculation and table 2 gives the actual calculation for the price component.

**Table 1 The values to be used to illustrate the calculation of aFRR component for 15 min ISP**

$i$	Balancing energy demand	$P_i$ , €/MWH	$P_{iup}$ , €/MWH	$P_{idown}$ , €/MWh	$V_i$ , €/MWH	$V_{iup}$ , €/MWH	$V_{idown}$ , €/MWH
$i_{1-100}$	Positive (up)	50	50		4	4	
$i_{101-150}$	Positive (up)	70	70		3	3	
$i_{151-225}$	Negative (down)	20		20	2		150

**Table 2 Calculation for aFRR component for 15 min ISP**

Price representing the upward balancing	Price representing the downward balancing	The average over all the prices established in BEPP (This is not relevant, as if there has been activation in both directions, this value is violating the boundary conditions)
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$\frac{\sum(P_{iup} * V_{iup})}{\sum V_{iup}}$	$\frac{\sum(P_{idown} * V_{idown})}{\sum V_{idown}}$	$\frac{\sum(P_i * V_i)}{\sum V_i}$
$\frac{\frac{50\text{€}}{\text{MWh}} * 4 \text{ MWh} + 70 \frac{\text{€}}{\text{MWh}} * 3 \text{ MWh}}{4 \text{ MWh} + 7 \text{ MWh}}$	$\frac{\frac{20\text{€}}{\text{MWh}} * 2 \text{ MWh}}{2 \text{ MWh}}$	$\frac{\frac{50\text{€}}{\text{MWh}} * 4 \text{ MWh} + 70 \frac{\text{€}}{\text{MWh}} * 3 \text{ MWh} + 2 * 20}{4 \text{ MWh} + 7 \text{ MWh} + 2 \text{ MWh}}$
$= 58,5 \text{ €/MWh}$	$= 20 \text{ €/MWh}$	$= 50 \text{ €/MWh}$

Now depending if the single price is calculated by the following the boundary condition of EBGL Article 55(4) or 55(5), either the positive or negative balancing energy price has to be chosen to be the aFRR price component for the 15 min ISP. The aFRR component representing the positive balancing energy adjusted for the 15 min is denoted as  $P_{aFRRup15}$ .

#### Using MP the aFRR price component for one ISP could be calculated as following:

Also in case of marginal pricing, there need to be separately calculated the marginal price for positive balancing energy and marginal price for negative balancing energy.

In case the single control cycle aFRR price is set by selected positive balancing energy bids, it is denoted as energy price  $P_{iup}$  for positive energy and the price component for the ISP is selected by

$$\max(P_{iup})(4).$$

In case the single control cycle aFRR price is set by selected negative balancing energy bids, it is denoted as energy price  $P_{idown}$  for negative energy and the price component for the ISP is selected by

$$\min(P_{idown}) (5).$$

By using the same numerical values of table 1 we have prices for both directions which are listed in table 3

**Table 3 Calculation for one aFRR price component for ISP, marginal pricing**

$\max(P_{iup})$	$\min(P_{idown})$
70 €/MWh	20 €/MWh

#### General formulas for the chosen methodologies

Now for one ISP the amount of different pricing components is depend on how many product the TSO is using for balancing. For illustrating purposes, the formulas are given such that it is assumed that all the platforms as well as specific products are used. The possible use of mFRR product for direct activation is excluded for simplicity. In case TSO is not using a product, the variables can be simply removed from the equation.

The variables to be taken into account in formulas are listed below

#### The CBMP prices per product for one ISP

These prices are assumed to be the CBMPs established according the all TSO proposal for EBGL Article 30(1). The aFRR component is calculated according to the section 2 of this annex, as the CBMPs are assumed to be determined per control cycle

*aFRR positive balancing energy price, that is adjusted for 15 min*  $= P_{aFRRup15}$

*mFRR positive balancing energy price =  $P_{mFRRup}$*

*RR positive balancing energy price =  $P_{RRup}$*

*Specific product positive balancing energy =  $P_{specific up}$*

*aFRR negative balancing energy price, that is adjusted for 15 min =  $P_{aFRRdown15}$*

*mFRR negative balancing energy price =  $P_{mFRRdown}$*

*RR negative balancing energy price =  $P_{RRdown}$*

*Specific product negative balancing energy price =  $P_{specific down}$*

### **The TSOs fulfilled demand for balancing energy volumes:**

These volumes should reflect the need that TSO has sent to the platform or requested from the local specific product. Again for aFRR the volume is calculated according the chapter 2 of this Annex.

*aFRR positive balancing energy demand for Picasso per 15 minutes =  $V_{aFRRup}15$ ,*

*mFRR positive balancing energy demand for MARI =  $V_{mFRRup}$*

*RR positive balancing energy demand for TERRE =  $V_{RRup}$*

*Balancing energy demand for specific products =  $V_{specific up}$*

*aFRR negative balancing energy demand for Picasso per 15 minutes =  $V_{aFRRdown}15$ ,*

*mFRR negative balancing energy demand for MARI =  $V_{mFRRdown}$*

*RR negative volume requested for TERRE =  $V_{RRdown}$*

*Balancing energy demand for specific products =  $V_{specific down}$*

### **General formula for VWAP:**

Similarly here, as with the aFRR calculation, it is important that for the calculation of the price, we will take into account always only one directional price, when calculating the prices in order to respect the boundary conditions of EBGL Article 55(4) and (5).

The general formula for the volume weighted average price resulting from positive balancing energy would be:

$$\frac{P_{aFRRup}V_{aFRRup15} + P_{mFRRup}V_{mFRRup} + P_{RRup}V_{RRup} + P_{specificup}V_{specificup}}{V_{aFRRup15} + V_{mFRRup} + V_{RRup} + V_{specificup}}. (6)$$

And same for the negative balancing energy would be:

$$\frac{P_{aFRRdown15}V_{aFRRdown15} + P_{mFRRdown}V_{mFRRdown} + P_{RRdown}V_{RRdown} + P_{specificdown}V_{specificdown}}{V_{aFRRdown15} + V_{mFRRdown} + V_{RRdown} + V_{specificdown}}. (7)$$

### **General formula for MP:**

For the positive balancing energy the general formula:

$$\max(P_{aFRRup15}, P_{mFRRup}, P_{RRup}, P_{specificup}). (8)$$

And for the negative balancing energy the general formula:

$$\min(P_{aFRRdown15}, P_{mFRRdown}, P_{RRdown}, P_{specificdown}). (9)$$

### **Example Case 1, only one direction demand for the whole area where balancing energy prices are formed**

Assume that there is no congestion for the whole ISP between imbalance area of TSO 1 and TSO 2 and both TSO 1 and TSO 2 have only demand for the positive balancing energy. This means that there is also only CBMP prices for positive balancing energy, as only positive balancing energy bids are activated. In

these examples only the positive balancing energy direction is presented, but the same logic works for the negative balancing energy, when there is only negative balancing energy demand and activations.

**The CBMP prices are same for both TSOs. CBMP prices per product for one ISP are:**

*aFRR positive balancing energy price, that is adjusted for 15 min =  $P_{aFRRup15}$*

*mFRR positive balancing energy price =  $P_{mFRRup}$*

*RR positive balancing energy price =  $P_{RRup}$*

*Specific product positive balancing energy =  $P_{specific up}$*

**The TSO 1's fulfilled demand for balancing energy volumes:**

*aFRR positive balancing energy demand for Picasso per 15 minutes =  $w_{aFRRup15}$ ,*

*mFRR positive balancing energy demand for MARI =  $w_{mFRRup}$*

*RR positive balancing energy demand for TERRE =  $w_{RRup}$*

*Balancing energy demand for specific products =  $w_{specific up}$*

**The TSO 2's fulfilled demand for balancing energy volumes:**

*aFRR positive balancing energy demand for Picasso per 15 minutes =  $q_{aFRRup15}$ ,*

*mFRR positive balancing energy demand for MARI =  $q_{mFRRup}$*

*RR positive balancing energy demand for TERRE =  $q_{RRup}$*

*Balancing energy demand for specific products =  $q_{specific up}$*

Now with the volume weighted average, the prices could be calculated using the formula 6.

Imbalance price for TSO 1:

$$\frac{P_{aFRRup}w_{aFRRup15} + P_{mFRRup}w_{mFRRup} + P_{RRup}w_{RRup} + P_{specificup}w_{specificup}}{w_{aFRRup15} + w_{mFRRup} + w_{RRup} + w_{specificup}}. (10)$$

And imbalance price for TSO 2:

$$\frac{P_{aFRRup15}q_{aFRRup15} + P_{mFRRup}q_{mFRRup} + P_{RRup}q_{RRup} + P_{specificup}q_{specificup}}{q_{aFRRup15} + q_{mFRRup} + q_{RRup} + q_{specificup}}. (11)$$

So when there has been no congestions, the balancing energy price component is same in both equations, but they are weighted differently by the volumes requested for the respective product. Even the volumes are local, the cross-border marginal price is regional for the uncongested area, where there was no congestion between the imbalance areas. As the price component is a dominant one in the weighted average equation, the demand of neighboring imbalance area in many cases affects the local imbalance price.

## Case 1 with VWAP

Table 4 Example values for case 1

Product	Volume demand TSO 1	Volume demand TSO 2	Price
aFRR (for 15 min)	10 MWh positive	30 MWh	40€/MWh



<b>mFRR</b>	20 MWh positive	15 MWh	35 €/MWh
<b>RR</b>	15 MW positive	0 MWh	30 €/MWh
<b>Specific product</b>	0 MW	5 MWh	20 €/MWh (local for TSO2)

Imbalance price for TSO 1:

$$\frac{40 \frac{\text{€}}{\text{MWh}} * 10 \text{ MWh} + 35 \frac{\text{€}}{\text{MWh}} * 20 \text{ MWh} + 30 \frac{\text{€}}{\text{MWh}} * 15 \text{ MWh} + 0}{10 \text{ MWh} + 20 \text{ MWh} + 15 \text{ MWh}} = 34,4 \text{ €/MWh}$$

And imbalance price for TSO 2:

$$\frac{40 \frac{\text{€}}{\text{MWh}} * 30 \text{ MWh} + 15 \frac{\text{€}}{\text{MWh}} * 20 \text{ MWh} + 0 + 20 \frac{\text{€}}{\text{MWh}} * 5 \text{ MWh}}{30 \text{ MWh} + 15 \text{ MWh} + 5 \text{ MWh}} = 32 \text{ €/MWh}$$

To illustrate a bit better the effect of the neighboring effect let's take a rather theoretical example:

<b>Product</b>	<b>Volume demand TSO 1</b>	<b>Volume demand TSO 2</b>	<b>Price</b>
<b>aFRR (for 15 min)</b>	1 MWh positive	1000 MWh	200€/MWh
<b>mFRR</b>	1 MWh positive	1000 MWh	150 €/MWh
<b>RR</b>	0 MW positive	0 MWh	not relevant as not used
<b>Specific product</b>	0 MW	0 MWh	not relevant as not used

Imbalance price for TSO 1:

$$\frac{200 \frac{\text{€}}{\text{MWh}} * 1 \text{ MWh} + 150 \frac{\text{€}}{\text{MWh}} * 1 \text{ MWh}}{1 \text{ MWh} + 1 \text{ MWh}} = 175 \text{ €/MWh}$$

And imbalance price for TSO 2:

$$\frac{200 \frac{\text{€}}{\text{MWh}} * 1000 \text{ MWh} + 150 \frac{\text{€}}{\text{MWh}} * 1000 \text{ MWh}}{1000 \text{ MWh} + 1000 \text{ MWh}} = 175 \text{ €/MWh}$$

So as the balancing energy prices will be determined by the CBMP, i.e for the area where there is no congestion and the balancing energy can be traded cross-border, the demand of the total uncongested area will determine the last bid activated and thus the balancing energy price. Now even the demands in the neighboring areas were really different, the common balancing energy price will affect the both areas.

### Case 1 with MP:

This can be formulated in the case of only upward direction need by the formula 3:

$$\max(P_{aFRRup}, P_{mFRRup}, P_{RRup}, P_{specificup})$$

Such that the price component of a certain process is taken into account only if there was a volume requested from that process.

The price with the same numerical examples in table 1:

TSO 's 1 imbalance price:

$$\max\left(40 \frac{\text{€}}{\text{MWh}}, 35 \frac{\text{€}}{\text{MWh}}, 30 \frac{\text{€}}{\text{MWh}}\right) = 40 \frac{\text{€}}{\text{MWh}}$$

The price of specific products is not relevant for TSO 1, as there was no specific products used.

TSO 2 imbalance price:

$$\max\left(40 \frac{\text{€}}{\text{MWh}}, 35 \frac{\text{€}}{\text{MWh}}, 20 \frac{\text{€}}{\text{MWh}}\right) = 40 \frac{\text{€}}{\text{MWh}}$$

The price of RR product is not relevant for TSO 2, as there was no RR product used.

**Example Case 2, two directional demand for the whole area where balancing energy prices are formed. TSO 1's demand is positive, TSO 2's demand is negative.**

Let's assume that TSO 1's imbalance price area has only need for positive balancing energy i.e. upward need and TSO 2 has only need for negative balancing energy. i.e downward need.

Now let's assume that for all the products the positive balancing energy demand is greater than negative one. There is no congestion between TSOs areas and due the planned implicit netting of the platforms only positive balancing energy is activated. This results in positive balancing energy price, i.e. there is no price reflecting the negative balancing energy need as no negative balancing energy was activated.

**Volume weighted average:**

Now the price calculation for the TSO 1 is simple, it goes with the equation 1 as there is requested upward volumes and also the prices available.

But for the calculation of the TSO 2, we have only the downward volumes, but as there has been only activation of upward bids, the prices do reflect the upward need. One way to calculate the price is to use the equation 1 regardless the requested volume direction:

$$\frac{P_{aFRRup}q_{aFRRdown} + P_{mFRRup}q_{mFRRdown} + P_{RRup}q_{RRdown} + P_{specificdown}q_{specificdown}}{q_{aFRRdown} + q_{mFRRdown} + q_{RRdown} + q_{specificdown}}$$

This calculation would be logical with the revenues that TSO 2 gets with the assumed TSO-TSO settlement, as the TSO 1 is paying the TSO 2 for the energy that TSO 2 exported for TSO 1 by the process the respective cross-border balancing energy price. So the same price for which the TSO 2 is receiving money is again paid for the BRPs. The imbalance price calculated like this for TSO 2 imbalance price area is however not reflecting the local downward need of TSO 2, but instead it is reflecting the overall uncongested area need. There is no downward price available due to the fact that no downward bids were activated because netting took care of that, there is no available price to be reflecting the downward need.

Another option in this case would be to use for example value of avoided activation for the imbalance price of imbalance area for TSO 2.

### Marginal price

For the TSO 1 the calculation goes straight with the equation 3

For the TSO 2, the calculation can go according the equation 3 or by choosing the value of avoided activation.

### The application of additional components

The table below shows, how the additional price components and the dual imbalance pricing can be applied. The additional components can be added or subtracted from the imbalance price calculated based on the methodologies presented above sections.

<b>Volume weighted average price of activated balancing energy prices (according to 5 (1) and (2) ISHP)</b>	<b>Marginal price of activated balancing energy prices (according to 5 (1) ISHP)</b>
<b>+ Scarcity/ Incentivising/ Financial neutrality components (according to 5 (3) ISHP)</b>	
<b>+ Application of dual imbalance pricing* (according to 8 (1) and (2))</b>	

\* components and the application of dual imbalance pricing are subject to local NRA approval.

#### **F. Survey outcomes of the TSOs intended approach to calculate imbalance price (not binding)**

36 TSOs were asked representing 33 countries.

Answers was received from 29 countries

15 TSOs answered that they intended use VWAP

10 TSOs answers that they intended use MP

4 TSOs answered other