SVENSKA KRAFTNÄT

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DISCUSSION PAPER

Svenska kraftnät's first views on the future imbalance settlement scheme

Disclaimer:
This document is a discussion paper prepared by Svenska kraftnät

1. Its purpose is to elicit discussion and gather opinions from market participants. All views and opinions are Svenska kraftnät's own and should not be regarded as Svenska kraftnät's final position.
2. It is based on a yet to be approved proposal from all European TSOs.
3. It may contain inaccurate assumptions.
4. In preparing this document, Svenska kraftnät has obtained feedback from the other Nordic TSOs, however the paper remains Svenska kraftnät's and the situation in the other Nordic countries has not been reviewed in a detailed fashion.

Content

1 Introduction

The Electricity Balancing (EB) Regulation[1] and the recast Electricity Regulation[2] set out the requirements that harmonised balancing markets and imbalance settlement schemes in Europe have to comply with[3]. While many of these requirements have already entered into force, some are still under development, as the EB Regulation requires transmission system operators (TSOs) across Europe to propose additional requirements to further specify and harmonise imbalance settlement. The proposal, known as the Imbalance Settlement Harmonisation (ISH)[4] proposal is yet to be approved, but it is already clear that the current common Nordic imbalance settlement scheme will need to evolve. In addition to the changes that will be required to comply with the approved ISH Proposal, we expect that developments in Nordic and European balancing markets, for instance the introduction of an energy activation market for aFRR, will also require changes to the imbalance settlement scheme.

Implementation of European regulation will result in several changes, among others, and in the scope of this paper, the following:

- The calculation of the *imbalance price*
- The calculation of the *imbalance* (including the calculation of an imbalance adjustment, a final position and an allocated volume)
- Additional rules, including requirements for the publication of information[5] and requirements for the submission of commercial trade schedules[6].

The fees that are currently levied on BRPs operating in the Nordic countries to cover costs related to balancing remain a national matter under the EB Regulation. Costs related to balancing may be passed on to BRPs following a consultation process and the approval of the relevant NRA, in accordance to article 44(3). Article 44(3) also requires a motivation for any mechanism other than a shortage pricing function for balancing energy. The BRP fee is further discussed in Appendix 1.

It is important to note that concerning European harmonisation, the ISH Proposal only seeks to harmonise the main principles and key design features of imbalance settlement. The formulation and approval of many elements of imbalance settlement are part of the national terms and conditions which are developed on national level and are approved by the national regulatory authority (NRA). Because the Nordic TSOs have a tradition of harmonisation which goes beyond what will be required by the ISH Proposal, Svenska kraftnät sees

[1] Commission regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing

[2] Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (recast)

[3] Norway i is not a member of the European Union, but a a member of the European Economic Area (EEA). European legilslation is not directly applicable in Norway, but may become so based on a specific process for ratification.

[4] Amended All TSOs' proposal to further specify and harmonise imbalance settlement in accordance with Article 52(2) of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing dated 11 November 2019.

[5] See article 12 of the EB Regulation

[6] Generation and consumption (operational) schedules are no longer relevant for imbalance settlement. The submission of these schedules is regulated under Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation ("the SO Regulation"). See Title VI Scheduling.

it as its aim to continue with a higher degree of harmonisation. Discussions are therefore under way to increase the understanding of the Nordic context and of the issues where Nordic TSOs are aligned and those where differences exist.

1.1 Scope and purpose of this paper

This discussion paper describes imbalance settlement under European regulation, and points to the aspects that require national decisions and that would require coordination to achieve a common Nordic imbalance settlement scheme.

The paper does not contain a concrete proposal for a common Nordic imbalance settlement scheme. Instead, it sets out the context and provides a comprehensive framework to discuss the options Svenska kraftnät sees available to the Nordic TSOs to achieve a common Nordic imbalance settlement scheme. In publishing this paper, Svenska kraftnät seeks to elicit discussion and gather opinions from stakeholders at an early stage of the process. The views expressed in this paper are preliminary, and should not be regarded as bindning.

When options are discussed, the paper assumes the implementation of the "Nordic target model". The transisional period - before the adoption of the imbalance settlement period (ISP) of 15 minutes and aFRR balancing energy activation market - is not the main focus of the report but is discussed as needed.

The paper includes legal references, qualitative discussions as well as conclusions and views. Readers should take note that this paper is based on the amended ISH proposal that all TSOs submitted to their respective NRAs in November 2019. In January 2020, because the NRAs could not reach a decision, the proposal was referred to European Union Agency for the Cooperation of Energy Regulators (ACER) in accordance with article 5(7) of the EB Regulation. In March, ACER held a public consultation regarding the harmonisation of imbalance settlement, and is expected to publish a decision on the proposal in July 2020. The final requirements may therefore differ from the ones included in this paper. We refer to these requirements as "proposed legal basis".

Quantitative analyses, and issues that are closely related to imbalance settlement like balancing energy pricing, the adoption of the 15-minute ISP, are outside of the scope of this paper. BRP fees are discussed in Appendix 1.

1.2 Overview of the current Nordic imbalance settlement scheme

Historically, TSOs in the Nordic synchronous area have relied on Frequency Containment Reserves (FCR[7]) and manual Frequency Restoration Reserves (mFRR) for balancing purposes. An automatic Frequency Restoration Reserve (aFRR) was introduced in 2013, but to a very limited extent - both in terms of hours and capacity. FCR is used to contain system

[7] FCR stands for Frequency Containment Reserve. In the Nordic countries, FCR consists of two products frequency-controlled normal operation reserve (FCR-N), and frequency-controlled disturbance reserve (FCR-D). Only FCR-N is considered in this paper.

frequency within the allowed frequency band around the nominal frequency 50 Hz after the occurrence of a system imbalance. aFRR and mFRR vary by the required response time, but are both used to restore the frequency to 50.00 Hz[8], and to relieve FCR.

While TSOs procure FCR and aFRR separately and in advance, the common Nordic mFRR market[9] relies to a large extent[10] on voluntary bids that BRPs or balancing service providers (BSPs)[11] submit to their respective TSO. For every ISP, bids are combined into a common Nordic merit order list and are activated in merit order except when transmission capacity constraints (congestion) between bidding zones force TSOs to disregard the merit order. When this happens, the price of mFRR balancing energy – and consequently the imbalance price – will be different in the affected bidding zones. Bids that are activated due to network constraints outside the merit order are carried out as special regulations and will not directly affect the calculation of the balancing energy price. Only bids that are activated for balancing purposes determine the price of balancing energy.

The settlement of imbalances is carried out by eSett Oy on behalf of the TSOs of Norway, Sweden and Finland. The Danish TSO will join the Nordic imbalance settlement in Q1-2021. eSett calculates an imbalance cost per imbalance price area (bidding zone), ISP (currently 60 minutes) and BRP as the product of the imbalance volume and the imbalance price.

The price of imbalances is the key incentive for BRPs to balance their portfolios. Today the Nordic TSOs apply dual imbalance pricing to production imbalances and single pricing to consumption imbalances and trade imbalances of production.

Table 1: Current pricing model for imbalances in the Nordic countries

	BRP imbalance Aggravating System imbalance [€/MWh]	**BRP imbalance Support System imbalance [€/MWh]**
Dual pricing for production imbalances		
System imbalance negative	Balancing energy market price (upregulation)	Reference price (day-ahead market price)
System imbalance positive	Balancing energy market price (downregulation)	Reference price (day-ahead market price)
Single pricing for consumption imbalances		
System imbalance negative	Balancing energy market price (upregulation)	Balancing energy market price (upregulation)

[8] Note that this is not the target at every moment of the balancing process due to the allowance of a frequency band.

[9] Balancing energy activation market traditionally known as the Regulation Power Market

[10] National capacity markets or reserve contracts are currently in place, e.g. RKOM in Norway, annual mFRR contracts in SE3 and SE4, the Swedish disturbance reserve.

[11] Finland has already introduced the BSP/BRP model as required in article 18 of the EB Regulation.

	BRP imbalance Aggravating System imbalance [€/MWh]	BRP imbalance Support System imbalance [€/MWh]
System imbalance positive	Balancing energy market price (downregulation)	Balancing energy market price (downregulation)

Table 1 shows how imbalances are priced. For production, a different price is set for BRP imbalances depending on whether the BRP imbalance aggravates or helps the system imbalance. When the system imbalance is negative, a BRP with a net imbalance that aggravates the system imbalance (a deficit in generation) pays the upregulation balancing energy market price for its deficit, which is more than it would have paid on the day-ahead market. A BRP with a net imbalance that helps the system (excess generation) receives the day-ahead market price. When the net system imbalance is positive, a BRP with a net imbalance that aggravates the system (excess generation) receives the downregulation balancing energy price for its surplus, normally less than the day-ahead market price. A BRP with an imbalance that helps the system (insufficient generation) pays the day-ahead market price.

For consumption imbalances, a BRP always gets/pays the balancing energy market price. When the system imbalance is negative, a BRP with a net imbalance that helps the system (lower consumption) receives the upregulation balancing energy market price, normally higher than the day-ahead market price. When the net system imbalance is positive, a BRP with a net imbalance that helps the system (higher consumption) pays the downregulation-balancing energy market price, normally lower than the day-ahead price, thus making a profit.

Dual imbalance pricing is a source of revenue for the Nordic TSOs, and this revenue is used to cover costs related to balancing and to achieve financial neutrality. In some countries in Europe, imbalances are priced to cover the costs borne by the TSO for balancing the system, i.e. using a so called cost-based approach. In the Nordic countries, however, costs such as the cost for procuring balancing capacity, administrative costs and and costs for up/down-regulation in same ISP are covered through network tariffs and fees charged to BRPs. Imbalances are priced using a so called priced-based approach, as a BRP that creates an energy imbalance (calculated per bidding zone and ISP) faces the marginal price for the mFRR balancing energy that is activated to resolve the corresponding residual system imbalance. The distinction between price-based and cost-based approaches may not always be straightforward though, as sometimes certain fixed costs may be recovered through the imbalance settlement. The ISH proposal outlines a price based approach.

Dual imbalance pricing for production incentivises BRPs to follow their production plans regardless of the system state balance. This is valuable from an operational perspective as it allows for a more predictable system operation. Dual pricing has also benefits when the system balance state does not fully reflect local congestions inside a bidding zone. In such cases, single imbalance pricing may not be the most efficient option from an operational perspective, as it may incentivise BRPs to actively respond to the system balance state very

close to real-time. This is known as self-regulation or self-balancing, and may in the presence of local congestions be counterproductive as it could trigger counter activations or redispatch actions, which have a negative impact on operational security.

In principle, the Nordic approach is rather robust and the pricing symmetry creates a well-balanced incentive structure. The requirements for imbalance settlement outlined in the EB Regulation follow a similar structure. Nevertheless, the Nordic TSOs have agreed to fully implement single pricing for pricing production imbalances by Q2 2021.

Finally, it is worth noting that in the Nordic countries, balancing energy flows between bidding zones are seen as one total exchange that is settled at a mid-price per border. For instance, a balancing energy flow from bidding zone A (BZA) to bidding zone b (BZB) is settled at the (BZA RPM marginal price + BZB RPM marginal price)/2. This exchange, which is part of the TSO-TSO settlement process and is therefore kept outside the imbalance settlelemt and the calculation of the imbalance price, creates significant costs for the TSOs that need to be covered by fees or tariffs.

2 Executive summary

Based on the EB Regulation, the recast Electricity Regulation, the amended ISH Proposal and cooperation agreements between the Nordic TSOs, the Nordic imbalance settlement scheme will face an extensive overhaul in the coming years. The main changes discussed in this paper are:

1. Implementation of one final single position equal to the sum of trade schedules
2. The use of single pricing for all imbalances
3. Price calculation based on;
    a. Imbalance price area (bidding zone) balancing energy demand
    b. European cross-zonal balancing energy prices
    c. Inclusion of aFRR balancing energy prices
    d. Value of Avoided Activation based on balancing energy bids, not the day-ahead price
    e. Application of value of lost load (VoLL) in case of activation of the strategic reserve and possibility to include scarcity pricing.

Even though the amended ISH Proposal is yet to be approved by ACER, the main changes listed above are quite certain.

Imbalance volume calculation follows the structure:

$$Imbalance = Allocated\ volume + Final\ position \pm Imbalance\ adjustment$$

- *Allocated volume*: Production, Consumption, and other energy volumes allocated to the BRP such as grid area imbalances
- *Final position*: The sum of the BRP's trade schedules including bilateral trade, ID trade and DA trade
- *Imbalance adjustment*: Adjustments in order to compensate for each activated balancing energy bid

Imbalance price calculation follows the structure:

$$Imbalance\ price = \text{Balancing energy price} + \text{additional component}$$

- Balancing energy price: The cross border balancing energy price for the type (aFRR, mFRR, RR) of balancing energy that was used to cover the balancing energy demand. Exact calculation is not yet determined
- additional component: An additional component, for instance a scarcity adder could be included in the imbalance price.

3 Design principles

The rules of imbalance settlement outlined in the EB Regulation and in the Electricity Regulation are based on a number of basic assumptions and principles that can be regarded as prerequisites for TSOs to observe when designing imbalance settlement schemes. In this section, we list the main design prerequisites. These are used as a baseline for the more detailed legal prerequisites and proposals presented in chapter 4 to 7.

Legal citations are reproduced in *Italic*.

3.1 General principles of the settlement processes

Article 44(1) of the EB Regulation sets out common principles that TSOs must take account when developing rules concerning the settlement process. In many cases, these principles also address the interdependencies between the settlement of balancing energy and the settlement of imbalances.

According to article 44(1), 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;

This principle is further described in section 3.4.

(c) provide incentives to balance responsible parties to be in balance or help the system to restore its balance;

This principle is further described in section 3.3.

(d) facilitate harmonisation of imbalance settlement mechanisms;

The ISH Proposal stems from article 52(2) of the EB Regulation.

(e) provide incentives to TSOs to fulfil their obligations pursuant to Article 127, Article 153, Article 157 and Article 160 of Regulation (EU) 2017/1485;

The listed articles refer to the SO Regulation and their content is as follows;

- Article 127: defines frequency quality target parameters
- Article 153: dimensioning rules for FCR
- Article 157: dimensioning rules for FRR
- Article 160: dimensioning rules for RR

This principle addresses the settlement of balancing services and implies that TSOs should not have any adverse incentives in relation to the FCR, FRR and RR dimensioning processes. The paragraph itself addresses specifically TSO incentives.

(f) *avoid distorting incentives to balance responsible parties, balancing service providers and TSOs*;

(g) support competition among market participants;

(h) *provide incentives to balancing service providers to offer and deliver balancing services to the connecting TSO*;

(i) *ensure the financial neutrality of all TSOs*.

Financial neutrality is further discussed in section 3.5. 3.3

3.2 Balance responsibility

As per article 5 of the Electricity Regulation, "*all market participants shall be responsible for the imbalances they cause in the system ('balance responsibility'). To that end, market participants shall either be balance responsible parties or shall contractually delegate their responsibility to a balance responsible party of their choice*…." . Also point (c) of article 18(6) of the EB Regulation sets out that all BRPs shall be financially responsible for their imbalances, as well as the fact that the terms and conditions for BRPs shall establish that BRPs shall settle their imbalances with the connecting TSO.

European requirements regarding balance responsibility are based on the "polluter pay" principle and are akin to current Nordic requirements, although the Electricity Regulation allows Member States to grant exemptions from balancing responsibility to small, renewable energy facilities and demonstration projects for innovative technologies.

3.3 Aim to keep own balance or help restore the system balance

Section (17) of the EB Regulation establishes that "*the general objective of imbalance settlement is to ensure that balance responsible parties keep their own balance or help restore the system balance in an efficient way and to provide incentives to market participants for keeping or helping to restore the system balance*". This is supported by the Electricity Regulation.

This provision establishes the general purpose of the financial incentives created by the imbalance settlement process. Together with the balance responsibility requirement and the use of the real-time value of energy to price imbalances, this provision ensures the application of the "polluter pays" principle, as the parties that create the costs are charged a price for their imbalances that reflects the real-time cost of energy.

However, it is not fully clear what "*help restore system balance*" means, and views sometimes differ. It is clear, however, that imbalance prices are not only about operational incentives in real-time, but also about mid-and longer-term incentives, even when reflecting the real-time value of energy. This means that even a TSO that does not allow a real-time response to the imbalance price through active imbalances and only allows BRPs to respond to imbalance prices through day-ahead and intraday trading may find imbalance prices important to provide longer-term incentives to BRPs.

3.4 The use of real-time value of energy

Both article 44(1) in the EB regulation and article 6.5 of the Electricity Regulation establish that imbalances shall be settled at a price that reflects the real-time value of energy. This requirement confirms a fundamental design principle already established in article 55 of the EB Regulation.

Imbalance pricing schemes based on a price-based approach need to determine how to translate the real-time value of energy into an imbalance price. This is somewhat straightforward when there is only one balancing energy market, as in the case in the Nordics today (the common Nordic mFRR balancing energy market). In the future, determining an imbalance price will be more complicated, as there are plans for a common Nordic market for aFRR balancing energy[12]. With different product prices available, a choice will have to be made between the marginal price of FRR, a volume-weighted imbalance price or a combination of the two.

3.5 TSO financial neutrality

Article 44(2) of the EB Regulation states that "*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.*"

As per above and per paragraph (i) of article 44(1) - see section 3.1 of this document - TSOs and relevant third parties must remain financially neutral with regard to the financial settlement of balancing energy, the exchange of energy between TSOs and the imbalance settlement process. Any economic surplus or shortage arising from these activities must be passed on to network users. Under which form this is done is to be decided at national level. This should not necessarily be interpreted as the network tariff since article 44(3) allows TSOs to develop a proposal for an additional settlement mechanism, separate from the imbalance settlement, to recover costs related to the procurement of balancing capacity, ad-

[12] For sake of clarity, the Nordics will also join the European activation markets for mFRR (MARI) and aFRR (Picasso).

ministrative costs, and other costs related to balancing. Article 44(3) also states that this additional settlement mechanism must be consulted and approved by the NRA, and that if a TSO proposes a mechanism other than a shortage pricing function, a motivation is required. Svenska kraftnät is of the opinion that this additional mechanism could be a BRP fee. BRP fees are discussed in Appendix 1.

3.6 The imbalance settlement period

Article 53.1 of the EB Regulation establishes that by December 18th 2020, "…*all TSOs shall apply the imbalance settlement period of 15 minutes in all scheduling areas*…".

At present, Nordic TSOs apply an imbalance settlement period of 60 minutes. Nordic TSOs are planning to request a derogation from the requirements of article 53.1 in accordance with article 62 of the EB Regulation. Current plans[13] are to fully comply with article 53.1 and implement 15 min ISP by Q2 2023.

[13] http://nordicbalancingmodel.net/nbm-building-blocks/

4 Introduction of single imbalance price and one single final position

The calculation of one single final position based on commercial trade schedules and the use of single imbalance pricing as main approach are key aspects of the EB Regulation. The current Nordic imbalance settlement scheme is not compliant with these requirements, so the future common Nordic imbalance settlement scheme will have to introduce these significant changes to the current imbalance settlement process. These changes are described and analysed separately in the below section.

Proposed legal basis (pending approval by ACER)

Calculation of a position (art. 4 amended ISH Proposal) *Each TSO applying a self-dispatching model shall calculate in each imbalance area for each ISP one single final position for each BRP as equal to the sum of its external and internal commercial trade schedules pursuant Article 54(3)(a) of the EBGL.*

> **External commercial trade schedule** (definition, art 3(75) SO) *A schedule representing the commercial exchange of electricity between market participants in different scheduling areas*[14];
>
> **Internal commercial trade schedule:** (definition, art 3(79) SO) *A schedule representing the commercial exchange of electricity within a scheduling area between different market participants*;
>
> **Position** (definition, art 2 (16) EB) *The declared energy volume of a balance responsible party used for the calculation of its imbalance*;

The use of single imbalance pricing (art.7 amended ISH Proposal)) *Each TSO shall implement the use of single imbalance pricing in accordance with Article 55 of the EBGL for all imbalances, except for the specific or all ISPs where a NRA approves the application of dual imbalance pricing in accordance with Article 8 of this ISHP*.

> **Single imbalance pricing** (definition, art 2(2a), ISHP) *For a given ISP in a given imbalance price area, the price for negative imbalance and the price for positive imbalance are equal in sign and size*.

Considerations

Nordic TSOs currently calculate two final positions per BRP, one for production and one for consumption and production trade imbalances. Article 4 of the amended ISH Proposal

[14] In the Nordic LFC block, a scheduling area is equivalent to a bidding zone.

requires that TSOs applying the calculation of two positions per BRP shall change to apply the calculation of one single final position per BRP.

Everything else equal, calculating a single position per BRP will reduce a BRP's financially settled imbalances, as all imbalances will be netted into one position. The size and characteristics of a BRP's portfolio will determine the extent to which a BRP will benefit from this netting.

Calculating a single final position per BRP will also simplify the allocation of the energy volume, the imbalance adjustment and should facilitate the participation of smaller flexible units in balancing markets. Smaller units of all types (generation, consumption, energy storages) can be aggregated into one balancing energy bid without the need to separate the resulting imbalance adjustments into two portfolios. Hence, BRPs and ultimately the BSPs, will be able to submit balancing energy bids that involve activation from both generation and consumption in one single bid. A condition to implement these changes is that the required IT-developments are in place when introducing the calculation of a single final position.

How a BRP's final position is calculated will also change. Today, final positions are calculated on the basis of production (operational) plans, but the EB Regulation requires the single final position to be calculated as the sum of a BRP's internal and external commercial trade schedules. A BRP's imbalance will therefore only be defined as the difference between its commercial trade (day-ahead, intraday and over the counter) and its actual production and consumption including imbalance adjustments. Combined with single pricing, this effectively puts an end to the current financial incentives to follow the notified (binding) production plan[15].

The change to single imbalance pricing for production imbalances means that the income derived from applying dual pricing to production imbalances will disappear. In the current Nordic system, the financial incentive for a BRP with production is to minimise its imbalance costs by following its binding plan. How effective this incentive is depends on whether dual pricing is applied in all ISPs or only in case of diverging ISPs (balancing energy activated in both directions). If only in diverging ISPs, the BRP will receive a single price if there has only been activation in one direction.

In contrast, all imbalances are priced equally under single pricing. If all imbalances are priced to reflect the price of balancing energy, BRPs that help the system and minimise the total system imbalance stand to have a financial upside. Single price may therefore provide BRPs with an incentive to take active imbalances by adjusting production and be reimbursed through the imbalance settlement scheme at a potential profit. This is however not free of risk; if during an ISP there are both upward and downward activations, the dominating direction for the ISP needs to be determined and it can be in the opposite direction of the BRPs active imbalance. BRPs may therefore have a financial incentive to self-balance

[15] A BRPs binding plans are the production plans and/or consumption forecasts available at the TSO 45 minutes before the delivery hour.

instead of making their flexible resources available as balancing capacity to the TSO. At he same time it could be noted that the risk to BRPs is likely to increase in the future due to more products, multiple cross-zonal marginal prices for each ISP (for aFRR in particular) and changing uncongested areas.

A BRP's ability to self-balance will be somewhat constrained by the characteristics of its portfolio. BRPs with a dispatchable portfolio should have a better possibility to self-balance to handle their own imbalances. BRPs with smaller or non-dispatchable portfolios are expected to be more passive. However, a BRP will only execute a self-balance strategy if it is more beneficial than placing bids as BSPs; in practice a combination of both is to be expected.

In systems characterised by local congestions, self-balancing may trigger counter activations or re-dispatching actions that can affect system operations in a negative way, as the price signal from the imbalance prices only reflect cross-zonal congestions, not internal congestions. An increased need for remedial actions may generate additional costs that will be on to network users. Furthermore, large amounts of self-balancing could also require increased margins within the grid to maintain sufficient operational security, which would also come at a cost.

Conclusions

- Following the introduction of one single final position per BRP and single imbalance pricing, production and consumption portfolios will be aggregated into a single position, and BRPs that support system balance will stand to make a profit. TSOs will lose the financial surplus (in Sweden, approximately 10 MEUR) generated by the settlement of production imbalances under dual imbalance pricing. These costs will have to be recovered, either in through the imbalance price, a BRP fee or some other process as TSOs have to achieve financial neutrality in accordance with paragraph (i) of article 44(2) of the EB Regulation.

- Imbalance settlement will no longer be a tool to ensure the quality of production (operational) plans. Production plans are not part of the imbalance settlement process and their submission falls under the scope of the SO Regulation. Further analysis is needed to establish how single pricing incentives (to support system imbalance) could be efficiently combined with incentives to provide production plans with good quality (or in theory, consumption plans).

5 Calculation of an imbalance

This section details how a BRP's imbalance volume is calculated in accordance with the EB regulation and the amended ISH Proposal. A BRP's imbalance across an ISP is calculated by applying the definition of imbalance from the EB regulation. The EB regulation also states how the data to be used in this calculation should be delivered. A BRP's imbalance volume will be subject to an imbalance price.

Legal basis

Imbalance calculation (art 54.1 EB Regulation): *Each TSO shall calculate within its scheduling area or scheduling areas when appropriate the final position, the allocated volume, the imbalance adjustment and the imbalance:*

(a) for each balance responsible party;
(b) for each imbalance settlement period;
(c) in each imbalance area.

Proposed legal basis (pending approval by ACER)

The calculation of one final position (art 4 amended ISH Proposal):
(1) Each TSO applying a self-dispatching model shall calculate in each imbalance area for each ISP one single final position for each BRP as equal to the sum of its external and internal commercial trade schedules pursuant Article 54(3)(a) of the EBGL.

The calculation of an allocated volume (art 4 amended ISH Proposal):
(3) The total allocated volume to each BRP in case of self-dispatching model shall be calculated by the connecting TSO, in each imbalance area for each ISP, over all injections and withdrawals for which the BRP is financially responsible in accordance with Article 17(2) of the EBGL, as the netted volume of:

(a) the volumes or aggregated volumes that are metered with a granularity of the ISP for the connections to a TSO grid;
(b) the volumes or aggregated volumes that are metered with a granularity of the ISP for the connections to a DSO grid;
(c) the aggregated volumes assigned to that BRP in case of the self-dispatching model per ISP over injections and withdrawals that are not metered with a granularity of the ISP;
(d) where applicable, according to each TSO's terms and conditions for BRPs, all corrections to Articles 4(3)(a), 4(3)(b) and 4(3)(c) of this ISHP that constitutes the volumes assigned per ISP to market participants bearing balance responsibility or that have contractually delegated their balance responsibility to a BRP of their choice; and
(e) where applicable, according to each TSO's terms and conditions for BRPs, the aggregated volumes assigned to that BRP, in case of the self-dispatching model, or scheduling unit of concerned BRP, in case of the central dispatching model, per ISP related to all residual energies.

The calculation of an imbalance adjustment (art 3, amended ISH Proposal):
(1) The imbalance adjustment to the concerned BRP shall be calculated by the connecting TSO in each imbalance area for each ISP as the netted volume of:

> *(a) all balancing energy volumes determined in accordance with Article 45 of the EBGL from all activated bids in that imbalance area for that ISP that assign this balancing energy to the concerned BRP;*
>
> *(b) all volumes activated by the connecting TSO for that ISP for purposes other than balancing, that are assigned to the concerned BRP.*

The calculation of an imbalance (art 4 amended ISH Proposal):
(6) The imbalance shall be calculated as equal to the energy volume representing the difference between the allocated volume and the final position, including any imbalance adjustment, in accordance with the definition of imbalance pursuant Article (2)(8) of the EBGL.

> *(a) each TSO applying a self-dispatching model shall calculate, in each imbalance area for each ISP, the imbalance of each BRP as the energy volume representing the difference between the allocated volume attributed to that BRP and the final position of that BRP, including any imbalance adjustment applied to that BRP, within a given ISP;*

Considerations

Imbalance, in this context, means deviations between generation, consumption and commercial transactions, including sales and purchases on organized markets and bilateral trades.

According to the EB Regulation, a BRP's imbalance across an imbalance settlement period shall be calculated as difference between allocated volume and final position, including imbalance adjustments:

$$Imbalance = Allocated\ volume - Final\ position\ \pm Imbalance\ adjustment$$

Where;

(a) The *Allocated volume* refers to the metered or profiled consumption and generation in each ISP;

(b) The *Final position* equals the sum of BRPs: external and internal trade schedules; where the external trade schedules mean trades resulting from day-ahead and intraday markets and internal trade schedules mean trades between BRPs within an imbalance area ;

(c) *Imbalance adjustment* refers to the balancing energy (FCR, aFRR and mFRR) volumes from all activated bids **and** all volumes activated for purposes other than balancing that is assigned to the concerned BRP.

Article 4 of the amended ISH Proposal requires that TSOs applying the calculation of two final positions per BRP shall change to apply the calculation of a single final position per BRP.

6 Determining an imbalance price

The purpose of this section is to detail the calculation of the imbalance price. Article 55(3) of the EB Regulation states that "*each TSO shall determine the imbalance price for:*

(a) each imbalance settlement period
(b) its imbalance price areas
(c) each imbalance direction."

As per the amended ISH Proposal, the imbalance price may be formed via what is referred to as "main components" and "additional components". The main components are the balancing energy prices and, where relevant, the balancing energy volumes. The three additional components available to TSOs to form the imbalance price are a scarcity component, a component to guarantee the financial neutrality of the TSO and an incentivising component to incentivise BRPs to close open positions on the day-ahead and intraday markets.

In section 5.1 we discuss the methodology for calculating the imbalance price. In section 5.2, we discuss the differences between determining an imbalance price for each uncongested area or of each imbalance price area/bidding zone. How balancing energy volumes are determined and how the satisfied energy demand is computed in the platforms is described in section 5.3, where we also discuss how system imbalance direction is determined and why it is essential to enable correct BRP imbalance pricing. The additional components are discussed sections 5.4 to 5.6. In section 5.7 we discuss the Value of Avoided Activation. Finally, In section 5.8, we discuss whether the activation of a strategic reserve should be reflected in the price of imbalances and in section 5.9 we discuss the application of dual imbalance pricing.

6.1 Main components in the imbalance price calculation

Legal basis

Imbalance price (art. 55.4 and 55.5, EB)

4. *The imbalance price for negative imbalance shall not be less than, alternatively:*

(a) the weighted average price for positive activated balancing energy from frequency restoration reserves and replacement reserves;

(b) in the event that no activation of balancing energy in either direction has occurred during the imbalance settlement period, the value of the avoided activation of balancing energy from frequency restoration reserves or replacement reserves.

5. *The imbalance price for positive imbalance shall not be greater than, alternatively:*

(a) the weighted average price for negative activated balancing energy from frequency restoration reserves and replacement reserves;

(b) in the event that no activation of balancing energy in either direction has occurred during the imbalance settlement period, the value of the avoided activation of balancing energy from frequency restoration reserves or replacement reserves.

Proposed legal basis (pending approval by ACER)

Components used for the calculation of the imbalance price (art. 5 amended ISH Proposal). Below we summarise the most relevant aspects to our discussion.

1 Establishes that before a TSO joins the European balancing platforms, the main components of the imbalance price shall be calculated using prices and volumes resulting from balancing actions. After the TSO joins the platforms, imbalance prices shall be calculated using only the components mentioned in (2), (4) and (5) below.

2 Lists the main components for calculating the imbalance price for a given imbalance price area and ISP:

- (a, b, c) the price or prices, per direction and product for the satisfied balancing energy demand of the connecting TSO (or connecting TSOs) of the imbalance price area, as calculated by the by the activation optimization function (AOF) of the European platforms for RR, mFFR and aFRR.
- (d) where applicable, the price or prices for balancing energy resulting from the activation of specific products for FRR and RR;
- (f) the value of avoided activation of balancing energy calculated in accordance with Article 6 the ISHP;
- (g) where applicable, the prices of further remedial actions of the TSO, which contribute to the system balance and are not covered by standard or specific products.

4 Establishes which energy volumes to use for calculating imbalance prices if calculating the weighted average price and/or for establishing the direction of imbalances (dominating direction in current Nordic terminology) in a given imbalance price area.

5 Allows for the inclusion of three additional components in the imbalance price

- (a) a scarcity component to be used in nationally defined scarcity situations, refer to section 6.4.
- (b) an incentivising component to be used to fulfil nationally defined boundary conditions, refer to section 6.5.
- (c) a component with regard to the financial neutrality of the connecting TSO, refer to section 6.6

NRAs must approve the conditions and methodologies for applying one or more additional components in the terms and conditions for BRPs (EB Regulation, article 18).

Considerations

The balancing energy prices that will be the inputs to the imbalance price are the cross-border marginal prices (CBMP) that will be computed by the AOF of the European platforms for each uncongested area and market time unit (MTU). CBMPs will be computed for standard RR, mFRR (with scheduled and direct activation) and aFRR balancing energy product bids for both activation directions. Because the Nordic TSOs do not use RR, the imbalance price will be calculated using CBMPs from mFRR and aFRR.

For ISPs in which no balancing energy has been activated, the Value of Avoided Activation (VoAA) of balancing energy shall be used. The calculation of the VoAA is discussed in section 6.7.

The amended ISH Proposal does not seek to harmonise the methodology for calculating the imbalance price. The chosen methodology is a decision of each TSO, but the methodology has to be approved by the relevant NRA in the national terms and conditions for BRPs.

Given the boundary conditions on the imbalance price and the restrictions on which components may be used to calculate it, two main methodology options emerge: a marginal value or a weighted average for the activated balancing energy from the relevant reserves[16]. In practice, a mix of the two approaches could also be a possibility, for instance a volume weighed average for aFRR and a marginal value for mFRR. In what follows, however, only the main options are discussed.

Under the first option, the imbalance price is computed as the highest positive or negative CBMP per ISP

$$Imbalance\ price\ option1 = \max(XBMP_{aFRR} + XBMP_{mFRR} + XBMP_{RR})$$

while the under the secong option, the imbalance price is computed as an energy volume (V) weighted average

$$Imbalance\ price\ option2 = \frac{(V_{aFRR} * XBMP_{aFRR} + V_{mFRR} * XBMP_{mFRR} + V_{RR} * XBMP_{RR})}{V_{aFRR} + V_{mFRR} + V_{RR}}$$

The two options will have different consequences for BRPs, but also BSP incentives will be affected by the choice of methodology, through BSP's and BRP's contracts with the resource owner and BSP-TSO contracts and obligations. The consequences are best illustrated with an example[17]:

> Assume all three reserves are used and the following volumes and cross-zonal marginal prices:
>
> $V_{aFRR} = 1$ $XBMP_{aFRR} = 15$
> $V_{mFRR} = 2$ $XBMP_{mFRR} = 10$
> $V_{RR} = 3$ $XBMP_{RR} = 5$

[16] Refer to article 55 and the all TSO imbalance settlement harmonisation proposal

[17] We don't take into account that there will be more than one price per product per ISP with the European platforms for the standard products and that a TSO may other products in addition

- Option 1. Imbalance price: 15
- Option 2. Imbalance price: 8.3 (or 11.7 without RR)

Under option 1, the imbalance price is higher than the price the BSP receives for delivering the cheaper products RR and mFRR. In the case of non-delivery, the BRP risks an imbalance cost that is higher than the payment for actual delivery. This means that the BSP will need to either include a risk premium when pricing its RR and mFRR bids, or alternatively include a risk premium when pricing the corresponding capacity if they participate in the capacity market. Another alternative to delivering bids/offers for RR and FRR would be to self-balance, as the imbalance price is higher than the marginal price paid for the cheaper products. This strategy, however, involves more risk as it requires a precise forecast of expected imbalance volume and price levels.

The total cost for the TSO for balancing energy (payments to the BSPs) is lower than the income generated by the imbalance settlement, creating a surplus for the TSO. This surplus has to be redistributed.

Under option 2, the imbalance price is lower than the price BSPs get for delivering the more expensive product aFRR. In this case, the resource owner might be incentivised to not deliver the requested balancing energy (offered by the BSP) but instead make a profit from the difference between the aFRR balancing energy price (BSP settlement) and the imbalance price (BRP settlement). This requires the resource owner to have enough information to do this trade off and have close contact with its BRP and BSP and is more probable to happen if the same entity has two or more of the roles.

The TSO can mitigate the risk of non-delivery by applying additional penalties, for example to the BSP for non-delivery of reserves. Depending on the penalty pricing, this would probably translate into a risk premium even though the actual delivery is safeguarded.

Option 2 will not generate the TSO surplus discussed in option 1, eliminating the need for redistribution. The need for BSPs to add a risk premium is significantly reduced but remains to some extent for BSPs delivering low price products. The impact on the TSO cash flows is therefore reduced.

It should be noted that no analysis has been made of how the different product prices will evolve over time, nor of the dynamics of aFRR pricing versus pricing in the mFRR platform MARI. The methodologies for pricing balancing energy and cross-zonal capacity used for the exchange of balancing energy or operating the imbalance netting process are a common proposal of all TSOs pursuant to Article 30(1), and have already been approved by all NRAs, while the determination of the balancing energy volumes to be settled with BSPs is developed at national level and approved by the NRA. The determination of balancing energy volumes is discussed in section 6.

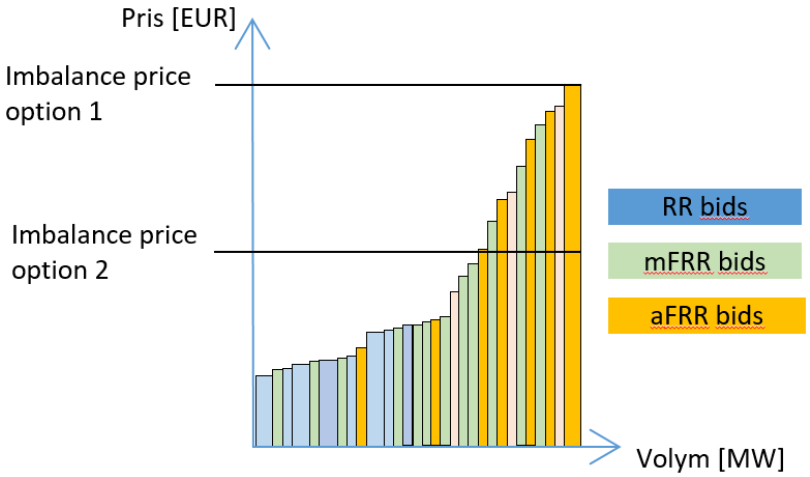

Figure 1: Common merit order list, showing only the activated balancing energy bids and the resulting imbalance price if option 1 or option 2 is used.

Conclusions

- The inclusion of prices and volumes from more than one product in the imbalance price will inevitably add complexity and have a significant impact on BRP incentives
- Svenska kraftnät favours option 1, to use the cross-zonal marginal price of activated balancing energy from both FRR processes (mFRR and aFRR), as the chosen methodology to compute the imbalance price. There are obvious pros and cons with both option 1 and 2, but option 1 reduces complexity and results in more robust incentives for delivery. However, a combination of the two approaches could be worth considering since it could be necessary to handle aFRR with a volume weighted average price due to the dynamics of the AOF pricing (with one marginal price per control cycle (i.e. every 4th second). Also, there may be more than one mFRR price available (due to scheduled and direct activateion of mFRR), or a mix of prices from both a standard and specific product.
- Since at present there is no Nordic aFRR balancing energy market, the only available FRR balancing energy price is the price from the common Nordic mFRR balancing energy market. This means that choosing option 1 will first impact the imbalance price (and the TSO/BRP/BSP cash flows) at a later stage. Nevertheless is it important to consider this design aspect when other aspects of the settlement design are discussed (for instance the use of metered or requested volumes).

6.2 Imbalance price calculation: per imbalance price area vs per uncongested area

As mentioned in section 5.1, the CBMP calculated by the AOFs of the European platforms - which are used to settle BSPs - will be the inputs to the calculation of an imbalance price. These prices are calculated for each uncongested area. European regulation, however, states

that an imbalance price shall be calculated for each imbalance area/bidding zone. Article 6.6 of the Electricity Regulation establishes that in self-dispatching models "*each imbalance price area shall be equal to a bidding zone*", which is the relevant area for BRPs that trade intraday and day-ahead. In the EB Regulation, the imbalance price area is defined as "*the area for the calculation of an imbalance price*" and the calculation of a BRP's single final position is proposed per imbalance area.

The reason why the area for the calculation of the imbalance price is set out to be the imbalance area/bidding zone - if European regulation is strictly applied - is that the satisfied balancing energy demand and the determination of dominating direction are (strictly) determined per imbalance price area even when there is free cross-zonal capacity available.

Calculating an imbalance price per imbalance area/bidding zone is a departure from the current principle in the Nordics where the imbalance price is determined per uncongested area, i.e. per set of one or more uncongested bidding zones (often the latter).

Whether all BRPs in an uncongested area should get the same imbalance price (as is the case today) or whether BRPs should get an imbalance price per imbalance area/bidding zone is a very important design question that deserves further analysis arises, as it affects BRPs incentives. Svenska kraftnät's current interpretation of the European legislation is that both approaches can be accommodated within the legal framework. Below we exemplify this rather fundamental issue that will have to be addressed in the common Nordic imbalance settlement scheme.

Assume two imbalance price areas A and B in a closed system with over 5 MW of free cross-zonal capacity between them (i.e. no congestion):

Table 2: Example with two imbalance price areas

Area	System balance [MW]	Action	Resulting system balance [MW]	Dominating direction
A	-10 (upward need)	Netting: +5 MW	-5 (upward need)	System short
B	+5 (downward need)	Netting: -5 MW	0	System long

The resulting system imbalance is resolved by activating a 5 MW FRR bid at a price of 30 EUR/MW. It does not matter whether the bid is activated in area A or B since there is sufficient free cross zonal capacity available.

In accordance to article 5 of the amended ISH Proposal ("*the price or prices, per direction for **the satisfied balancing energy demand** of connecting TSO or connecting TSOs **of this imbalance price area***"), the imbalance price in area A is set at 30 EUR/MW.

But what is the imbalance price in area B? Area B has a local balancing need in the opposite direction from the dominating direction *of the uncongested area*. The resulting imbalance price could either be:

a) A result of the **need of the uncongested area**. The dominating direction of the uncongested area has an upward direction (-10+5 = -5 → system is short), the imbalance price in area B would then be 30 EUR/MW and incentivise self-balancing in a direction that aggravates the imbalance price area imbalance.

b) A result of the **need of the imbalance price area**. The imbalance price in area B would then be set to the VoAA (refer to section 6.7) since no activations have taken place.

The example can obviously be repeated with other system imbalances, for instance 0 MW in area A and 10 MW in area B.

There are good arguments for both alternatives.

Alternative a) is in line with the current Nordic model where imbalance prices follow the balancing energy price in the uncongested area. However, this is done in conjunction with dual imbalance pricing for production imbalances in order to minimise self-balancing. Alternative a) provides a more global pricing signal to the market, which could be beneficial from a system standpoint in the long run.

Alternative b) limits the price incentives to a representation of the imbalance price area need. Imbalances (and open loop ACE) will not be impacted by imbalances in neighbouring imbalance price areas. The advantages are thus local price incentives, and incentives not to react in real-time increasing the imbalance of the imbalance price area (even if reduces the imbalance of the uncongested area) with potential impact on dimensioning.

The amended ISH Proposal is based on alternative b). It remains to be seen whether the concept of uncongested area is in line with the approved regulation, which is expected to be more accommodating than the proposal.

Conclusions

- Svenska kraftnät is - from an imbalance price design perspective - inclined to support an approach where imbalance pricing is linked to the concept of uncongested area, alternative “a” above. This approach is in line with current practices as the link to the corresponding balancing energy market is perceived to be more straightforward. Furthermore, in the short run - before introduction of ACE-based balancing in the Nordics - alternative “b” is associated with implemantion difficulites, refer to section 9.3. However, in the long run, there are arguments for alternative “b”, which limits cross-zonal self balancing incentives even though self balancing incentives are kept intact on a zonal basis, which also is in line with the reserve dimentioning targets.

6.3 Imbalance price calculation: satisfied balancing energy volumes and dominant direction of the system imbalance

The satisfied balancing energy demand volumes that are used in the calculation of the XBMPs that are in turn used to calculate the imbalance price are calculated by the European platforms (and will equal balancing energy demand from the TSO if there are sufficient available bids). These volumes may be complemented with balancing energy volumes from national specific products or additional remedial actions.

The main process to establish the satisfied balancing energy demand is described below.

The connecting TSO submits balancing energy bids and balancing energy demand per bidding zone (imbalance price area) and cross-zonal capacities to the market coupling platform(s) where the platform's AOF merges the bids from each bidding area into a common merit order list (CMOL) and determines the activation requests (selected bids), the satisfied balancing energy demand (by activation or netting), and used transmission capacity and cross-zonal market flows. The platform's TSO-TSO settlement function determines, among other things, the settlement prices for the intended cross-zonal exchange of balancing energy. The net sum of the cross-zonal exchanges and the balancing energy activated within the bidding zone constitutes the satisfied balancing energy demand volume, while the cross-zonal marginal price constitutes the price for the balancing energy.

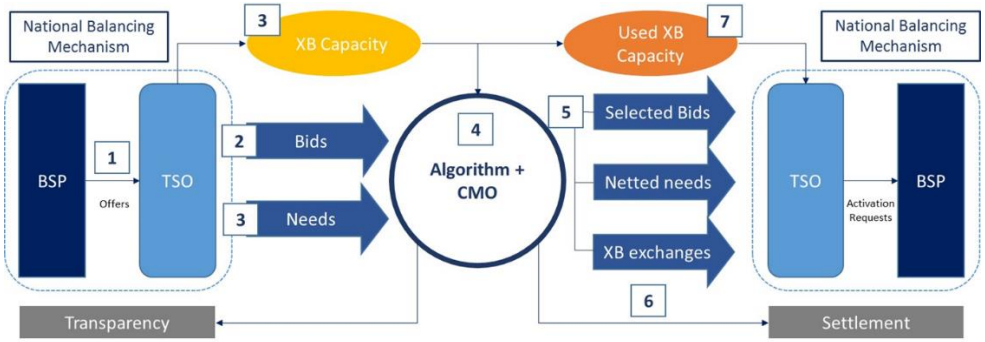

Figure 2: A schematic overview of the European market coupling platforms. Source: Platform projects Mari and Picasso and ENTSO-E Working group AS.

The satisfied balancing energy demand and the balancing energy prices are then used as input to the imbalance settlement.

It is important to note the difference between

> *the balancing energy demand*, which refers to the balancing energy a TSO needs to balance the imbalance price area

- *the satisfied balancing energy demand*, which refers to the actual balancing energy that was allocated to the imbalance price area in order to meet the demand
- *the activated balancing energy bids*, which refers to the balancing energy bid volume that was activated by the AOF in the imbalance price area independent on whether this was due to internal or external needs.

The balancing energy volumes can be used for two purposes, as described below. It should be noted the methodology for determination of system imbalance direction is not subject to harmonisation under the amended ISH Proposal, and remains therefore a TSO decision.

1. In case the imbalance price is calculated as a volume weighed average or to simply calculate this boundary condition, refer to section 1.

   The calculation of an imbalance price should obviously include all volumes and prices from FRR and RR that have been used to balance the system, independently whether these are standardised products used for cross-zonal exchanges or local specific products only available for internal use.

2. When the direction (up/down) of the system imbalance are determined.

   The direction of the (imbalance price area) system imbalance can be determined by summing up all balancing energy volumes that have been activated (or exchanged) in order to satisfy the balancing energy demand. The direction can thereafter be used to determine which BRP imbalances that reduces or aggravates the system imbalance. Currently this is calculated based on activated volumes of mFRR in the uncongested area.

   On the similarities and the differences with "Current system balance" to be published as soon as possible, refer to section 7. The direction of system imbalance is currently determined based on activated balancing energy that satisfies the corresponding demand. This is consequently a result of the TSO actions and ends up in one imbalance direction per ISP. The calculation ends up in an energy volume with the unit [MWh/ISP,BZ], but is actually merely an direction indicator – positive or negative. The "Current system balance" on the other hand is an instantaneous (or minute-by-minute) value that represents the total need of balancing power [MW/BZ], and not restricted to the need with is satisfied through FRR and RR

Determining the system imbalance direction is paramount to enable correct BRP imbalance pricing, and it is essential that it includes all balancing energy volumes; whether to include other components should be thoroughly discussed.

6.4 Additional components in the imbalance price: scarcity component

Proposed legal basis (pending approval by ACER)

Scarcity component (art 9.6 amended ISH Proposal): *The connecting TSO or connecting TSOs of an imbalance price area may propose in the relevant terms and conditions for BRPs the conditions and a methodology to calculate additional components, to be included in the imbalance price calculation. In that case, this TSO or these TSOs shall propose one or more of the following additional components:*

(a) a scarcity component to be used in nationally defined scarcity situations;

Legal basis

Scarcity pricing (Nordic TSO cooperation agreement): *The balancing market design shall provide adequate price signals for balancing services and imbalance settlement for the Parties, BSPs and BRPs, per 15-minute time period and per bidding zone. Scarcity pricing shall be applied. Scarcity situations shall be defined based on the FRR dimensioning rules, see Annex 3.*

Considerations

The ISH Prpopsal allows TSOs to include a scarcity component in the imbalance price to be applied in ISP in which pre-defined scarcity situations in the local system have been observed. In this way, the imbalance price – which should reflect the real-time value of energy - will reflect local scarcity situations and therefore provide a signal to market participants of the current situation. It should be noted that this is actually a requirement set out in the the Nordic TSO cooperation agreement[18], which states that scarcity pricing shall be applied to provide adequate price signals for balancing services and imbalance settlement for BSPs and BRPs, per 15-minute time period and per bidding zone.

Neither the ISH Proposal or the Nordic Cooperation Agreement detail the actual design of the scarcity component, which means that TSOs have to choose among several possible approaches. It should be noted that while the ISH Proposal allows for a national solution, the Nordic Cooperation Agreement is silent on this respect, other than the price signals shall be provided per bidding zone.

There are different approaches to scarcity pricing in the Nordic countries today. In Sweden, the current balance responsibility agreement between BRPs and Svenska kraftnät includes a simplistic form of scarcity pricing[19]. A very high price that approaches the Value of Lost Load (VoLL) is applied during situations when the system is approaching a critical balancing capacity shortage which may require extraordinary actions like the disconnection of load. In Denmark and in Finland, the imbalance price stays on the level of the last activated mFRR bid, in other words, a scarcity component is not in use.

[18] Cooperation agreement (Nordic balancing cooperation), page 6.

[19] Balansansvarsavtalet, bilaga 2 Allmänna villkor för balansansvarig, 4.4.1 Prissättning av Balanskraft

The rationale behind scarcity pricing is that two dimensions of imbalance pricing must be considered in order to provide correct incentives to BRPs, operational security and economic efficiency. Under normal operation when system imbalances can be resolved using available balancing resources, the primary objective of system balancing should be to maximise the level of economic efficiency, i.e. that the marginal socioeconomic benefit of system balance equals the marginal socioeconomic cost. The socioeconomic benefit is realised either by minimising imbalances or by activating balancing energy. Both measures will incur a cost for society. If both measures are correctly priced – without regulatory interventions – both measures will be equally valued and taken in a manner that achieves economic equilibrium. In other words, a BRP will be incentivised to reduce the total system imbalance (or its own imbalances is case of dual imbalance pricing) until it is more economically efficient to activate balancing energy via the balancing energy market.

In scarcity situations there is an increasing risk that system imbalances cannot be resolved using available balancing resources. Operational security is jeopardized, and there is a proportionally increasing risk for unintended disconnection of loads. The unintended disconnection of loads is an additional cost for society[20]. If this cost in not reflected in the imbalance price, BRPs will face an imbalance price lower than the cost for society and will not be incentivised to strive towards the economic optimum. This additional cost can be added as a scarcity component to the imbalance price. In theory, if the risk for disconnection of loads equals one (i.e. loads are disconnected), the imbalance price should equal the VoLL.

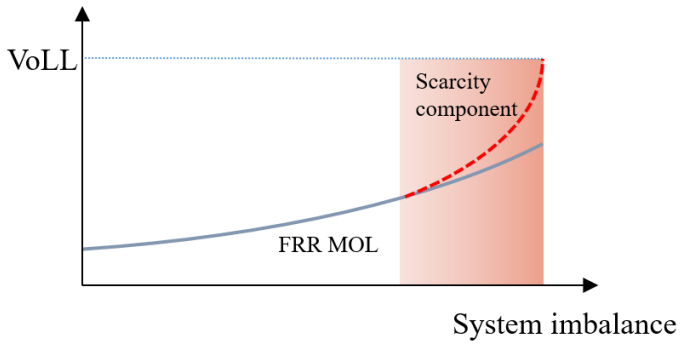

Figure 1: When the system imbalance enters a predetermined scarcity situation, the Scarcity component allows the imbalance price to deviate from the marginal balancing energy price in order to represent the risk of disconnection of loads.

It is important to note that this is a theoretical and rather simplified description of the scarcity component. The design of a scarcity component requires many different considerations and analyses. For instance, how is a scarcity situation defined? How will BRPs internalise the increased financial risk? Should the scarcity components be symmetrical, and if not - how shall the TSO surplus be distributed? It should be noted that asymmetrical scarcity

20 The cost for society is probabilistic - one can say that it is the probability for Loss of Load (LOLP) multiplied by the value of lost load (VOLL).

pricing involves the application of dual pricing, which requires a separate NRA approval, refer to section □.

Scarcity pricing is however not the only solution for handling situations where few remaining balancing bids are available. For instance, the long term likelihood of scarcity situations should can be reduced by facilitating the participation of demand-side response in the balancing markets. Another supplementary alternative, which has been piloted by Fingrid, is to provide the market with additional real-time transparency information in critical balancing situations. This alternative gives market participants additional information on balancing prices thereby gives them the information needed to react and provide balancing bids if they find it favourable. Currently in Finland, the price of the activated balancing bids are published in real time on those situations when cross zonal connections to other Nordic countries are congested and only mFRR bids located in Finland are possible to activate.

It should be noted that scarcity pricing is about price signals to market participants. TSOs in the Nordic countries can also resort to a number of coordinated actions to remedy specific situations in which a shortage of mFRR bids is expected[21]. For instance, fast mFRR bids with hight volumes can be activated out of price order or TSOs may contact mFRR providers that did not submit mFRR bids and invite them to (voluntarily) place bids. If the system is in the alert state, and risks entering the emergency state, TSOs may request immediate changes in production or consumption within their control area, or restore to manually activated load-shedding.

Most importantly on the subject of a scarcity component is to investigate what the actual problem is that we would like to solve by introducing a scarcity component. First when this is completely clear, is it possible to access which measure is most effective and fair for solving the problem.

6.5 Additional components in the imbalance price: incentivising component

Proposed legal basis (pending approval by ACER)

Components used for the calculation of the imbalance price (art 5(5) amended ISH Proposal): *The connecting TSO or connecting TSOs of an imbalance price area may propose in the relevant terms and conditions for BRPs the conditions and a methodology to apply one or more of the following additional components, to be included in the imbalance price calculation:*

[21] See articles 3 and 4 of the Amended Nordic synchronous area proposal for coordination actions aiming to reduce FRCE as defined in Article 152(14) and measures to reduce FRCE by requiring changes in the active power production or consumption of power generating modules and demand units in accordance with Article 152(16) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation, approved on July 11th, 2019.

(b) an incentivising component to be used to fulfil nationally defined boundary conditions;

Considerations

The purpose of an *incentivising component* is to incentivise market participants to close open positions on the day-ahead or intraday markets and not wait for imbalance settlement. This is achieved by an imbalance price that is at least as high (low) as the local day-ahead or intraday price. The incentivising component can be seen as an alternative to current Nordic design where balancing market and imbalance prices are capped and floored by the day-ahead market price (as intraday liquidity is currently marginal).

Once the European platforms for FRR and RR become operational, the main components of the imbalance price will include the cross-zonal marginal prices of FRR and RR balancing energy calculated at the platforms. However, even though balancing markets (and by consequence, imbalance settlement) are coupled, gate closure for intraday trading in some European countries will take place at the same time or after the common gate closure for the balancing energy platforms. Because the conditions for price formation in balancing and intraday markets are different (e.g. gate closure time, market area, market participants, auction/continuous trade) market players could potentially exploit the possibility of intermarket price spreads. This "adverse incentive" risks impacting system operation in a negative way as TSOs would need to handle larger balancing energy flows and more imbalances, in turn leading to higher costs.

TSOs may therefore want to add an incentivising component, for instance equal to the difference between the intraday and balancing energy prices, to ensure that the imbalance price is at least as high as the intraday price. This would discourage rational market players from not closing their position before imbalance settlement.

Adding an incentivising components generates a surplus to the TSO, as imbalances are settled at a price higher that the cost of balancing energy.

Conclusion

- At this stage, Svenska kraftnät does not foresee the use of an incentivising component in the imbalance price. Nevertheless it is too early to discard the use of an incentivizing component to the imbalance price. The European platforms for balancing energy are still some years away from becoming operational, many aspects are still to be decided and there is no operational experience. Also, intraday market design is likely to evolve, possibly facilitating the inclusion of an incentivizing component in the imbalance price.

6.6 Additional components in the imbalance price: financial neutrality of the connecting TSO

Proposed legal basis (pending approval by ACER)

Components used for the calculation of the imbalance price (art 5(5) amendea ISH Proposal): *The connecting TSO or connecting TSOs of an imbalance price area may propose in the relevant terms and conditions for BRPs the conditions and a methodology to apply one or more of the following additional components, to be included in the imbalance price calculation:*

> *(c) a component with regard to the financial neutrality of the connecting TSO pursuant Article 44(2) of the EBGL.*

Considerations

The amended ISH Proposal allows the inclusion of an additional component in the imbalance price to make sure that TSOs remain financially neutral. The reason is that European regulations does not seek to harmonise how TSOs shall achieve financial neutrality, it is left to the discretion of each NRA. The financial neutrality component is intended to be used in cost-based imbalance settlement schemes where a TSO surplus from the imbalance settlement is required in order to cover other costs related to balancing, such as procurement costs of balancing capacity, IT or administration.

Conclusions

- Svenska kraftnät plans to primarily continue to use BRP fees and network tariffs to ensure financial neutrality, however, we remain open to this option.

6.7 Value of avoided activation

Legal basis

Imbalance price (art 55, EB Regulation)
(1) *Each TSO shall set up rules to calculate the imbalance price….*

(2) *The rules pursuant to paragraph 1 shall include a definition of the value of avoided activation of balancing energy from frequency restoration reserves or replacement reserves.*

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

(5) The imbalance price for positive imbalance shall not be greater than, alternatively:
(a) ..

(b) in the event that no activation of balancing energy in either direction has occurred during the imbalance settlement period, ***the value of the avoided activation*** *of balancing energy from frequency restoration reserves or replacement reserves.*

Proposed legal basis (pending approval by ACER)

Value of avoided activation (definition, art 2(d) amended ISH Proposal): *a reference price that can be calculated by the TSO or TSOs of a given imbalance price area after the balancing energy gate closure time for a given ISP, at least when there is no balancing energy demand or balancing energy activation in the direction of the balancing energy demand for that imbalance price area for that ISP.*

The value of avoided activation of balancing energy from frequency restoration reserves or replacement reserve (art 6, amended ISH Proposal)
(1) The value of avoided activation shall:

(a) set the boundary conditions to the imbalance price in accordance with the Articles 55(4) and 55(5) of the EBGL;

(b) set, where relevant, the boundary conditions to the imbalance price for non-aggravating imbalance in accordance with Article 8(2)(b)(i) of this ISHP; and

(c) be calculated taking into account the general settlement principles in accordance with article 44(1) of the EBGL.

(2) Each TSO shall calculate the value of avoided activation from frequency restoration reserves or replacement reserves for at least each ISP during which there has been no activation of balancing energy in either direction for the imbalance price area,

(4) For calculating the value or values of avoided activation in accordance with Articles 6(2) or 6(3) of this ISHP, each TSO may only, if relevant, use the following prices:

(a) the bid price or bid prices, per direction, for balancing energy for frequency restoration process available to this TSO for this ISP from BSPs connected to this TSO, or from the integrated scheduling process;

(b) the bid price or bid prices, per direction, for balancing energy for replacement reserve process available to this TSO for this ISP from BSPs connected to this TSO, or from the integrated scheduling process.

In addition to serving as a reference price, the value of avoided activation may also serve as the imbalance price for non-aggravating imbalances in case dual imbalance pricing is applied;

Definition of conditions and methodology for applying dual imbalance pricing (article 8, amended ISH Proposal)

(2) In case of application of dual imbalance pricing pursuant to Article 8(1) of this ISHP, the TSO shall calculate an imbalance price:

(a) for aggravating imbalances []

(b) for non-aggravating imbalances in accordance to either:

*i. **the methodology for calculation of the value of avoided activation pursuant to Article 6 of this ISHP**, and including, where relevant the components pursuant to the Articles 5(5) of this ISHP; or*

ii. in accordance with the national methodology for single imbalance pricing based on the components and boundaries pursuant to Article 5 of this ISHP, and including, where relevant the components pursuant to the Article 5(5) of this ISHP.

Considerations

The Value of Avoided Activation (VoAA) of balancing energy functions as a reference price that can be used to calculate the imbalance price the normal way in ISPs in which there is no activation of FRR and RR in an imbalance price area. In the Nordics, the current corresponding reference price[22] is set to the corresponding day-ahead clearing price in the case that there is no mFRR price.

The amended ISH Proposal provides no clear definition of the VoAA, but includes some principles for its calculation. Article 6.4 establishes that the VoAA may only be calculated using the bid price or prices, per direction, for balancing energy from FRR and RR available to the TSO for the relevant ISP from BSPs connected to the TSO[23]. The reason for this is that imbalance pricing must reflect the real-time value of energy and must provide incentives to balance or help balance the system. Therefore, the VoAA must be calculated using the same price components as discussed in section 5.1 of this document, with the difference that the components in section 5.1 refer to actual activations of aFRR and mFRR balancing energy (and RR when applicable), whereas for VoAA no activations have taken place. How these values are to be used to determine the VoAA, is left to the discretion of the TSO.

ACER is expected to remove the limitation to only use bids from BSPs connected to the TSO, which means that also bids from the CMOL (and not only from the local merit order lists (LMOLs) will be available to TSOs . If this limitation is not removed, the available design choices are fewer.

It is worth noting that which bids to use is not straightforward, even with the limitation that the available bids are bids from a TSO's LMOLs. It is unclear whether "*bids available to the TSO from BSPs connected to the TSO*" refers to bids available in an imbalance area or available in the TSO's control area, which may include more than one imbalance area. If the latter, bottlenecks within the control area need to be taken into account.

[22] Balansgrundpris

[23] The limitation to only use bids from BSPs connected to the TSO is expected to be removed in the current process with ACER

Linking the imbalance prices and the VoAA to the LMOL represents a change in methodology for the Nordics. In the current Nordic approach the reference price (and the calculation of imbalance prices) are determined based on uncongested areas instead of local balancing energy demand (in a bidding zone) or local merit order lists. The general aspects for this is also discussed in section 6.2.

Rejected alternatives

As described in the Explantory document of the ISHP, there are in theory a number of alternatives that could serve as reference price. For the sake of completeness, these options are elaborated below:

1. Ex-ante fixed price
2. Equal to the imbalance price in the preceding ISP
3. Day-ahead clearing price
4. A price calculated from intraday trade

Ex-ante fixed price. In accordance with the general principles of the settlement process described in section 2.1, imbalances shall be settled at a price that reflects the real time value of energy. By extension, any prices that are derived ahead of real time may risk introducing an obsolete and adverse price signal, why an ex-ante fixed price can be assumed to be an inefficient reference price.

Equal to the imbalance price in the preceding ISP. A reference price equal to the imbalance price in the preceding ISP is closer in time but is still associated with complications. As the imbalance price is derived from the balancing energy price(s), it will reflect the need during the preceding ISP, which won't necessarily have the same characteristics as the current ISP.

Day-ahead clearing price. Day-ahead market clearing prices could serve as reference price per today, but prices are 12 to 36 hours old and do not reflect the real time value of energy.

In the current Nordic market design (implicitly assuming limited intraday trade), it is perceived as efficient to introduce a link between day-ahead and real time to ensure consistency across timeframes. This link is a price cap/floor equal to the day-ahead clearing price on mFRR balancing energy bids. The reference price therefore falls somewhere between the price of up- and downward balancing energy bids. In addition, in practice there is little liquidity in the intraday markets, and balancing prices don't normally have a high spread to the day-ahead price. Consequently, the day-ahead price can normally be regarded as a quite sound reference within the current context.

European balancing market design does not include this link. However, a link between the day-ahead and imbalance prices may be proposed via the incentivising component in accordance with point (b) in paragraph 5 of article 5 of the amended ISH Proposal (see section 6.5). This link would, however, directly link the day-ahead and imbalance price and

would not affect the balancing energy bid ladders so its function would be slightly different. In this context it is worth highlighting the future change from Nordic to European cross-zonal balancing energy marginal prices, where prices will be a result of common European balancing energy merit order lists and available cross-zonal capacity[24].

A price calculated from intraday trade. Intraday prices could potentially provide a better alternative as the time window between intraday and balancing energy gate closures is short (1 hour, or less in some cases). The most obvious difficulty is that intraday trade is mostly based on continuous trading (only in the Nordics currently) and lacks enough liquidity to properly formulate a representative closing price. A reference price must therefore be calculated based on time, price and volumes.

Rules to handle discontinuities between upward and downward regulating bids.

Following the implementation of the European methodology for pricing balancing energy as per article 30(1) of the EB Regulation, and the launch of the European platforms for balancing energy exchange, balancing energy bids will no longer be limited by cap and floor prices[25]. This means that the current cap and floor on mFRR bids - the day-ahead market clearing price – will be removed. The absence of upper and lower bounds introduces the risk of a discontinuous bid ladder, meaning that the lowest upregulation bid can be lower than the highest downregulation bid. Such a discontinuous bid ladder should be a rather limited problem, but one that nevertheless needs to be handled.

In theory (in an uncongested area), a discontinuous bid ladder could indicate a market inefficiency, a potential trade between two BSPs that never took place. In practice, the discontinuous bid ladder could be the result of errors or approximations in market rules. For instance, if the VoAA is determenied based on a CMOL that is the result of merging LMOLs from imbalance areas with different balancing energy prices and cross-zonal congestion, area price differences may appear as a discontinuous bid ladder in the VoAA determination.

Based on theoretical reasoning, such cases could be handled by setting the VoAA equal to the price where the upward and downward bid ladders meet (right figure below). The VoAA would then represent a theoretical case in which all efficient trade has been carried out.

[24] Refer to EBGL, Title II, chapter 2 and the ongoing MARI and Picasso implementation projects.

[25] See article 10 of the Electricity Regulation establishes that "*there shall neither a maximum nor a minimum limit to the wholesale electricity price. This provision shall apply, inter alia, to bidding and clearing in all timeframes and shall include balancing energy and imbalance prices, without prejudice to the technical price limits which may be applied in the balancing timeframe and in the day-ahead and intraday timeframes*". There will, however, still be technical bid limits equal to +/- 99,999 €/MWh.

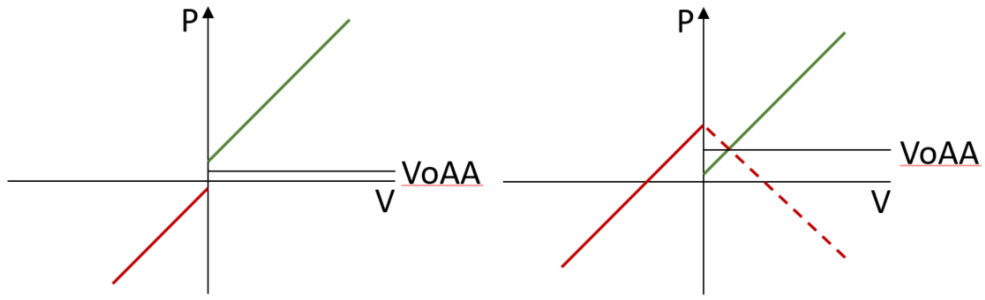

Figure 3: Left picture illustrate a normal case where VoAA is calculated based on a continuous bid ladder. Right picture illustrate a possible way to calculate VoAA from a discontinuous bid ladder.

Finally, it should be noted that the imbalance price may potentially develop in a discontinuous way when the reference diverges from the balancing energy activations. This is of primary importance in cases where estimated imbalance prices are published in real time (refer to section 7), and of lesser importance if imbalance prices are published after real-time.

Conclusions

Article 6.4 of the amended ISH Proposal requires the VoAA to be calculated using the bid price or bid prices, per direction, for balancing energy from the FRR and RR process available to the TSO from BSPs connected to the TSO. A possible solution would be to set up a national bid ladder, that from the start only includes mFRR (and later on aFRR), and a VoAA that equals the mid-value of the first upward and downward bid. In cases where the bid ladder is discontinuous, the VoAA should equal the price where the upward and downward bid ladders meet.

Svenska kraftnät is also considering a target model that aims for cross-zonal imbalance prices in order to allow the imbalance price to incentivise self-balancing consistently in the uncongested area. This is further described, and illustrated with an example, in section 5.2. This is in line with current Nordic market rules, but it is currently unclear whether it will be in line with the approved ISH Proposal. However, since this procedure will incentivise cross-zonal self-balansing based on system imbalances in other imbalance price areas, its implementation should be aligned with other self-balancing mitigation measures.

6.8 Imbalance pricing and the dispatch of strategic reserves

Legal basis

Design principles for capacity mechanisms (art 22.2 Electricity Regulation): *The design of strategic reserves shall meet the following requirements:*

> *(b) during imbalance settlement periods where resources in the strategic reserve are dispatched, imbalances in the market are to be settled at least at the value of lost load or at a higher value than the intraday technical price limit as referred in Article 10(1), whichever is higher.*

Considerations

Dispatching resources in the strategic reserve will directly impact the imbalance price during those specific imbalance settlement periods when the strategic reserve is dispatched.

At present only Finland and Sweden have a strategic reserve. Sweden has rules establishing how the activation of the peak load reserve for balancing purposes impacts the mFRR balancing energy price for upward regulation[26]. These rules, however, are not compliant with the Electricity Regulation and will be updated as needed.

Conclusion

- The activation of the strategic reserve ahould be reflected in the imbalance price. Svenska kraftnät is considering combining this with the design of the scarcity component. This means that the previously discussed scarcity component offsets the imbalance price and that the imbalance price is set to VoLL when resources in the strategic reserve are dispatched or when load is disconnected.

6.9 Application of dual imbalance pricing

The amended ISH Proposal allows for dual imbalance pricing based on predefined specific conditions and after NRA approval. The conditions and the NRA approval procedure is detailed under Article 8.

Proposed legal basis (pending approval by ACER)

Definition of conditions and methodology for applying dual imbalance pricing (art 8 amended ISH Proposal):

(1) *Each TSO may propose to its relevant regulatory authority the application of dual imbalance pricing in an imbalance price area based on one of the following conditions, where relevant:*

(a) For specific ISPs in which the TSO subsequently requests activation of both positive and negative balancing energy from frequency restoration reserves, if dual imbalance pricing is justified as a mitigation measure to avoid negative effects on FRCE target parameters in accordance with Article 128 of SOGL, frequency stability in accordance with article 3(34) of SOGL and/or the ability to maintain power flows within the power flow limits in accordance with Article 32(1) and (2) of SOGL as a result of BRPs acting on price incentives.

(b) Not relevant in the Nordic countries.

(c) For specific ISPs in which the component in accordance with Article 5(5)(a) of the ISHP is larger than EUR 0 /MWh.

[26] See Balance Responsibility Agreement 3829-1, section 6.2.1 (in Swedish). Updated agreement 1 May 2020

This condition is relevant only if the imbalance price includes a scarcity component.

(d) Not relevant in the Nordic countries.

(e) For all ISPs where the imbalance settlement period is 60 minutes due to an exemption from the requirement pursuant to Article 53 of the EBGL or based on derogation in accordance with Article 62(2)(d) of the EBGL.

The Nordic TSOs are not appling for a derogation from article 53.

(2) *In case of application of dual imbalance pricing pursuant to Article 8(1) of this ISHP, the TSO shall calculate an imbalance price:*

(a) for aggravating imbalances in accordance to the national methodology for calculating a single imbalance price for that ISP, pricing based on the components pursuant to Article 5 of this ISHP, and including, where relevant the components pursuant to the Article 5(5) of this ISHP;

(b) for non-aggravating imbalances in accordance to either:

i. the methodology for calculation of the value of avoided activation pursuant to Article 6 of this ISHP, and including, where relevant the components pursuant to the Articles 5(5) of this ISHP; or
ii. in accordance with the national methodology for single imbalance pricing based on the components and boundaries pursuant to Article 5 of this ISHP, and including, where relevant the components pursuant to the Article 5(5) of this ISHP.

In addition, article 8 requires that TSO provide a justification for the implementation of dual pricing based on operational and economic reasoning and criteria taking into account the requirements set out in the EB and SO regulations.

Considerations

The main purpose of dual imbalance pricing is to avoid providing financial incentives to self-balance[27]. Nordic TSOs are concerned that a 60 min ISP gives a more imprecise price signal for the system need, which may also fluctuate within such a time period, than within a 15 min ISP. Moving to single pricing for production before implementing a 15 min ISP at the same time as removing the financial incentive to follow production plans has the potential to trigger power oscillations under certain conditions, hampering system operation.

Paragraph (d) of article 52.2 of the EB regulation allows for the application of dual imbalance pricing according to the conditions and methodologies proposed by European TSOs in

[27] See Nordic TSOs discussion paper on imbalance pricing available at http://nordicbalancingmodel.net/wp-content/uploads/2019/11/Discussion-paper-on-imbalance-pricing.pdf

the amended ISH Proposal. The amended ISH Proposal includes several conditions under which TSOs might choose to apply dual pricing.

It is important to note that paragraph 1(a) only provides the general outline of the condition under which dual pricing in diverging ISPs may be implemented. The criteria for applying dual imbalance pricing is that FRR has been activated in diverging directions for a bidding zone, but many details are yet to be defined, for instance how to define for which ISPs activation has occurred in both directions and how imbalance prices for aggravating and non-aggravating imbalances are to be computed.

Conclusion

The Nordic TSOs have consulted the operational concerns arising from single imbalance pricing with Nordic stakeholders. Based on the feedback received, the Nordic TSOs have decided to not propose the application of dual pricing. Alternative measures to mitigate self-balancing are currently under discussion.

The Nordic TSOs have considered but decided against applying dual pricing for specific ISPs in which the TSO subsequently requests activation of both positive and negative balancing energy from FRR until the implementation of 15 min ISP. It may, however be may be necessary to revaluate this decision in the future.

7 Publication of information

Legal basis

Balancing (art 17, Transparancy Regulation[28]):

1. *For their control areas, TSOs or where applicable operators of balancing markets, where such markets exist shall provide the following information to the ENTSO for Electricity:*

    g. imbalance prices per balancing time unit;

    h. total imbalance volume per balancing time unit;

Publication of information (art 12, EB Regulation)[29]:
2. All entities referred to in Article 1(2) shall ensure that information in paragraphs 3 to 5 is published at a time and in a format that does not create an actual or potential competitive advantage or disadvantage to any individual or companies.

3. 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;

Balancing market (art 6.13 Electricity Regulation):
Transmission system operators or their delegated operators shall publish, as close to real time as possible but with a delay after delivery of no more than 30 minutes, the current system balance of their scheduling areas, the estimated imbalance prices and the estimated balancing energy prices.

High level design of the aFRR-platform (art 3(16), Implementation framework aFRR platform[30]): *Each participating TSO shall publish the exchange of volumes and prices provided by the AOF as soon as possible and no later than 30 minutes after the relevant aFRR MTU.*

High level design of the mFRR-platform (art 3(17), Implementation framework mFRR platform[31]): *Each participating TSO shall publish the exchange of volumes and prices provided by the AOF as soon as possible and no later than 30 minutes after the relevant end of the relevant mFRR MTU.*

[28] Commission regulation (EU) No 543/2003 of 14 June 2013 on submission and publication of data in electricity markets

[29] Article 12 also requires the publication of information from the balancing energy activation markets (e.g. bid data) and balancing capacity markets (e.g. procured capacity, reservation of cross-zonal capacity). The balancing energy bids are obviously of importance for the imbalance settlement since the imbalance prices are derived from these bids. This is however out of scope for this paper.

[30] ACER Decision on the Implementation framework for aFRR Platform in accordance with Article 21 of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing: Annex I, 24 January 20

[31] ACER Decision on the Implementation framework for mFRR Platform in accordance with Article 20 of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing: Annex I, 24 January 2020

Proposed legal basis (pending approval by ACER)

Components used for the calculation of the imbalance price (art 5, amended ISH Proposal): *(6) Where the relevant NRAs have approved in the terms and conditions for BRPs the conditions and the methodology to apply one or more additional components in accordance with Article 5(5) of this ISHP, the value of the additional components shall be published by the TSO for those ISPs in which the additional components were applied.*

Considerations

One the aFRR and mFRR platforms become operational, TSOs will be required to publish the exchange of volumes and prices provided by the AOF as soon as possible and no later than 30 minutes after the relevant end of the relevant MTU. The prices provided by the AOF are the CBMPs per uncongested area, while the volumes correspond to satisfied mFRR balancing energy demands; their publication is straightforward.

Other European regulation, however, requires the publication of the following balancing information, per bidding zone[32], not later than 30 minutes after real-time:

Table 3: Publication of data related to imbalance settlement

Information	Unit	Description
Current system balance	Direction (Surplus/deficit) and MW	The ACE open loop, which is the instantaneous area power imbalance.
Estimated balancing energy price	EUR/MWh, ISP, BZ	An estimation of the balancing energy price, that is determined after the ISP
Estimated imbalance price	EUR/MWh, ISP, BZ	An estimation of the imbalance price, that is determined after the ISP

The purpose of this information is to enable market players to understand the current imbalance context, regardless of desired BRP behaviour real-time, to help keep and/or restore the system balance within the relevant terms and conditions for BRPs. In this context, real-time is likely to be understood as an instantaneous value, or in practice, times series with minute resolution.

Estimating balancing energy and imbalance prices is not straightforward, and European regulation does not specify how to do it. Several challenges arise, especially in the transition phase before the introduction of the 15-min ISP:

- Imbalance prices must be determined per ISP so any estimate before the end of the ISP will inevitably be a forecast with a probability it will be erroneous.
- The price of balancing energy (and consequently the imbalance price) is the result of the cross-zonal exchange of balancing energy. Any estimate must therefore take both

[32] In the Nordic countries, scheduling areas, bidding zones and imbalance price areas match.

local energy bids and system balancing energy needs into account, as well as global prices and energies.

- Balancing energy prices are determined per uncongested area (imbalance areas). Because congestions evolve over an ISP, the TSO has to forecast the formation of imbalance areas as well.

- Not all bids to the common Nordic mFRR market are activated for balancing purposes. Some bids are activated for remedial actions (special regulation) such as redispatching and some countertrading actions to deal with congestion.

Information on the current system balance in a number of scheduling areas in continental Europe is already being published at the Transparency platform[33], see Figure 2.

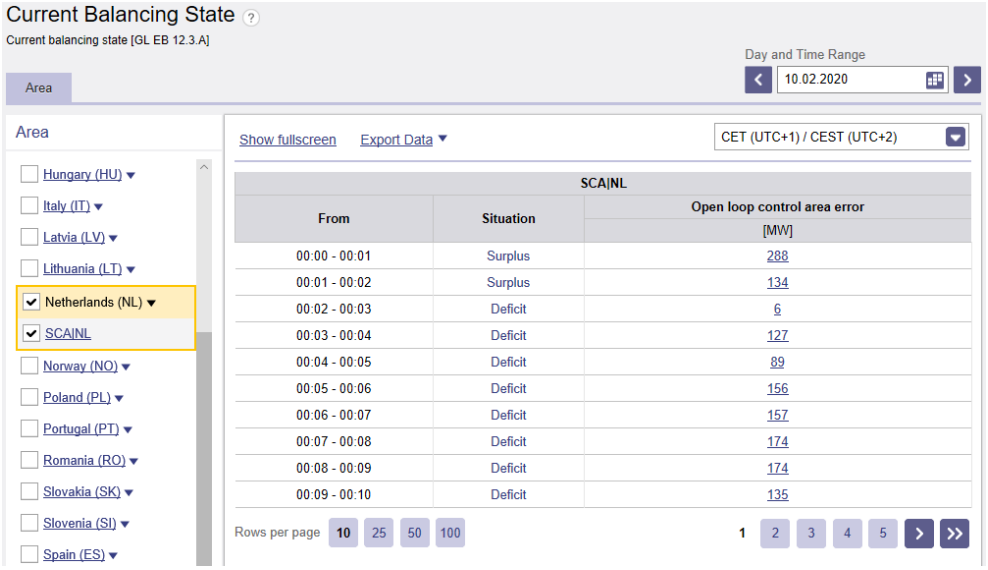

Figure 2: An example of publication of system balance (here understood as the ACE open loop) at the Transparency platform. Source: transparency.entsoe.eu

The Nordic TSOs have previously expressed concern about the negative impact on the efficiency of TSO balancing and congestion management actions and consequently on operational security of the financial incentive to self-balance associated with single imbalance pricing[34]. A real-time information feedback loop on current system balance and the estimation of balancing energy and imbalance prices could make the system more predictable to BRPs, reducing the risks associates with self-balancing. It should be noted that increased complexity once the platforms for aFRR and mFRR become operational will make understading the available information more difficult.

[33] https://transparency.entsoe.eu/balancing/r2/currentBalancingState/show

[34] See section 3 in this paper as well as "*Nordic TSOs discussion paper on imbalance pricing*" available at http://nordicbalancing-model.net/discussion-paper-on-imbalance-pricing-published-feedback-and-input-welcomed-by-1-january-2020/

A strong self-balaning response to large imbalances and high prices may end up overcompensating for the system imbalance, triggering an opposite self-balancing response that sets off power oscillations in system balance. The ability of the TSOs to ensure frequency stability and to contain power flows within the accepted limits is therefore affected. An overcompensation caused by self-balancing is counteracted with activation of balancing energy with another time constant and geographical location. Such situations therefore also impact negatively on the FRCE, i.e. ACE or frequency deviation depending on the LFC area.

Real-time information on current system balance reflects the current need for positive or negative balancing energy. The system balance and price signals may however not reflect local congestions inside a bidding zone why strong self-balancing behaviour may be counterproductive and impact negatively on the operational security by compromising the TSO's ability to maintain power flows within the power flow limits and thereby an increased risk to overload transmission system elements.

Conclusions

- The EB regulation and the Electricity Regulation require that TSOs publish current system balance as well as price estimates no later than 30 minutes after real-time. Svenska kraftnät intends to abide by this requirement and will publish the required data as close to real-time as the related processes allows. Svenska kraftnät assumes that the publication of real-time data will contribute towards a level playing field between those market players that are active in the balancing market and those who are not.
- System operational concerns remain and if deemed necessary, Svenska kraftnät will re-evaluate whether the publication of data should be limited (within the legal framework) in order to support efficient operation.
- Estimation of price is not specified in the legal framework. Svenska kraftnät propose to at least some extent harmonise how these estimations are done.

8 Financial considerations

The introduction of a new common Nordic imbalance settlement scheme will change the financial implications for both TSOs and BRPs. BRPs as well as TSOs should consider the following aspects:

1. TSOs have to make a choice as to which methodology to use to calculate the imbalance price: a marginal value or a weighted average for the activated balancing energy from the relevant reserves. This design choice will impact the imbalance price and the TSO's financial neutrality.

2. Under single imbalance pricing, the surplus generated from the settlement of production imbalances with dual pricing, the spread between day-ahead price and the marginal price of balancing energy, disappears.

3. Under single imbalance pricing, BRPs stand to make a profit if their actions help resolve the system imbalance. That is, if for a given imbalance price area and for a given ISP, the BRPs imbalance is equal in sign to the net volume of balancing energy demand of the TSO.

4. The introduction of a scarcity component in the imbalance price introduces a new financial incentive for BRPs.

5. The legal requirement that imbalances shall be settled at the VoLL in case the strategic reserve is dispatched will increase the BRP financial risk.

6. Under a new imbalance pricing scheme, the calculation of collaterals will have to be revised.

9 Implementation timeline

A high-level implementation timeline for the common Nordic imbalance settlement scheme is outlined in the joint Nordic Balancing Model (NBM) roadmap[35]. A more detailed timeline focusing on the implementation of the European imbalance settlement scheme, divided in three phases until the target model is fully implemented, is provided below.

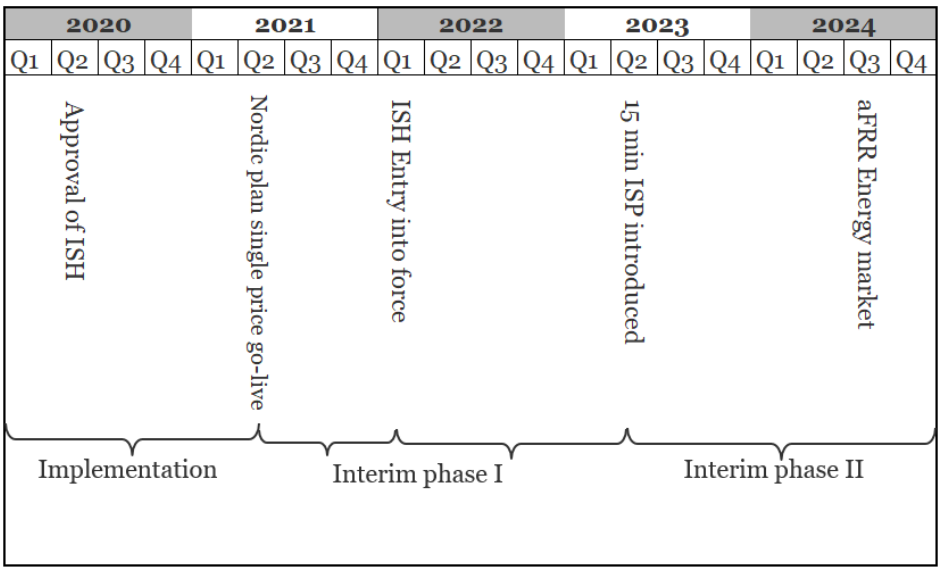

Figure 4: Implementation timeline for the common Nordic imbalance settlement scheme

9.1 Implementation

In accordance with paragraph 4 of article 52 of the EB Regulation, the implementation date of the amended ISH Proposal must be no later than 18 months after its approval. The amended ISH Proposal has been referred to ACER following the NRAs inability to make a decision. ACER has 6 months to review and make a decision, so the amended ISH Proposal should be approved by mid-July 2020 at the latest.

TSOs are free to propose an earlier implementation date and the Nordic TSOs plan is to implement single price in Q2 2021. However, assuming ACER decision in July 2020 as well as related national NRA approval processes. , the Nordic TSOs may need the full 18 months for the necessary adjustments to IT systems, agreements and BRP fees, which would imply an adjustment of the current timeline in the NBM roadmap.

9.2 Interim phase I

[35] Available at nordicbalancingmodel.net

The Nordic TSOs plan is to request a derogation, in accordance with article 62 of the EB Regulation, from the requirements of article 53 to adopt an Imbalance Settlement Period (ISP) of 15 minutes by December 2020. The Nordic TSOs plan to propose that the derogation period extends until Q2 2023, which, if granted, would mean that single imbalance pricing would be implemented 18-24 months before the adoption of the 15-minute ISP.

Nordic TSOs foresee that, due to the current Nordic balancing scheme is not designed to support self-balacing, adopting single imbalance pricing before moving to a 15-minute ISP could be detrimental to operational security. Also other forthcoming changes (for instance increased volumes of aFRR) are expected to result in more active market participants in the balancing timeframe. The Nordic TSOs therefore investigatepossible measures to mitigate self-balancing, including requesting the application of dual imbalance pricing in specific ISPs in accordance with paragraph (1) of article 8 of the amended ISH Proposal. The current assumption is however to avoid dual pricing schemes but use other mitigation measures.

9.3 Interim phase II:

The measures currently under investigation to mitigate self-balancing are mainly intended for the transitional phase before the adoption of the 15-minute ISP. Further adjustments to the imbalance settlement process may however be introduced together with 15 min ISP.

It is important to note that the European target model is based on the assumption that ACE-based balancing is applied. The Nordic synchronous area (eleven bidding zones/imbalance price areas) is however operated as one LFC area (FRCE equals the frequency) where the balancing energy demand – in case of mFRR - is determined per “mutually regulated area” which in turn is a set of bidding zones that together constitutes an uncongested area. The configuration could obviously change between different ISPs. In case of aFRR, the demand (LFC controller input) is determined by the frequency and bid activations are carried out pro-rata.

This discrepancy between the current Nordic balancing scheme and the European target model is fully recognised by the Nordic TSOs and the NBM program is a corner stone when this gap is bridged. Therefore, it is probable that additional adjustments of the imbalance settlement scheme is introduced in conjunction to the launch of the first version of area based balancing in Q2 2023.

9.4 Target model

The European target model for imbalance settlement foresees the inclusion of activated aFRR balancing energy bids in the calculation of the imbalance price. A prerequisite is the establishment of the common Nordic aFRR balancing energy market. The timeline for this market is yet to be detailed, but the Nordic TSOs will publish the TSO strategy in Q2

2021[36]. The common Nordic aFRR balancing energy market will connect to the corresponding European market coupling currently developed under the PICASSO project.

At this point in time the Nordic MACE model will be fully implemented in the Nordics, and it is therefore likely that additional adjustments in the imbalance settlement scheme can be implemented at this point in time.

Once the common Nordic aFRR balancing energy market is implemented, the BRP settlement process will receive more than one marginal price (aFRR and mFRR) as described in section 3.2.

[36] Nordic Balancing Model Roadmap report, November 2019, chapter 5.8

Appendix 1 The balance responsibility fee

In order to finance activities within its System Operations business area, Svenska kraftnät and the other Nordic TSOs apply fees on BRPs. These fees, usually refered to as the BRP fees ("balansansvarsavgift"), cover costs related to ancillary services[37] as well as other operating costs. The requirements in article 44 of the EB, together with forthcoming changes including the adoption of single imbalance pricing for production imbalances and one single final position for BRPs, mean that the structure of the BRP fees will have to be reviewed.

Legal basis

General principles (art 44(1) (f),(g) and (i), 44(2) and 44(3) of the EB Regulation.

(1) *The settlement processes shall:*

(f) avoid distorting incentives to balance responsible parties, balancing service providers and TSOs;

(g) support competition among market participants;

(i) ensure the financial neutrality of all TSOs.

(2) *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.*

(3) *Each TSO may develop a proposal for an additional settlement mechanism separate from the imbalance settlement, to settle the procurement costs of balancing capacity pursuant to Chapter 5 of this Title, administrative costs and other costs related to balancing. The additional settlement mechanism shall apply to balance responsible parties. This should be preferably achieved with the introduction of a shortage pricing function. If TSOs choose another mechanism, they should justify this in the proposal. Such a proposal shall be subject to approval by the relevant regulatory authority.*

Considerations

The purpose of BRP fees is to ensure that the Nordic TSOs remain financially neutral.

[37] Ancillary service in this text = FCR, FRR

The current fee regime in the Nordic countries is only partially harmonised; while the structure is harmonised, the level of the fee is not.

- Basic fee for consumption XX EUR/MWh
- Basic fee for production XX EUR/MWh
- Imbalance fee for consumption imbalance max 0,5 EUR/MWh
- Weekly fee 30 EUR/week.

The basic fees cover the costs related to the procurement of balancing capacity, administration including personnel, consultants, IT, and other costs related to balancing, including depreciation costs and fees to eSett and ENTSO-E.

At present there is an agreed (harmonised) range for how the costs for reserves that are used for both ancillary services and network services shall be allocated.

The imbalance fee for consumption has a harmonised cap of 0,5 EUR/MWh. This fee was introduced to give consumers incentives to keep balance, and to recover the costs for handling imbalances resulting from the introduction of single imbalance pricing for consumption.

The weekly fee of 30 EUR per week is the same throughout the Nordic countries. Its purpose is to cover the costs for the administration of balancing responsible parties incurred by eSett.

The items that are included in the settlement of imbalances that have an effect on Svenska kraftnät's earnings are the profit from production imbalances, imbalance flows between bidding zones and, to a lesser extent, trades to redistribute production within the delivery hour. Because these items largely cancel each other out, the balance responsibility fee must cover the remaining costs.

Article 44(2) of the EB Regulation establishes that if a TSO is not financially neutral in respect to the settlement of imbalances, any positive or negative financial outcome shall be passed on to network users. This requirement is not compatible with the principles for cost distribution that Svenska kraftnät has applied in the past, and does not rhyme well with the polluter pays principle.

Article 44(3) of the EB Regulation provides the legal framework for a balance responsibility fee. It enables TSOs to develop a proposal for an additional settlement mechanism, separate from the imbalance settlement, to recover costs related to the procurement of balancing capacity, administrative costs, and other costs related to balancing. Article 44(3) also sets out that this additional mechanism should preferably be implemented as a shortage pricing function for balancing energy. If a TSO proposes a mechanism other than a shortage pricing function, a motivation is required. The proposal should be the subject of a public consultation before it is submitted to the relevant NRA for approval. Because an additional

settlement mechanism is a national matter (pursuant to article 5(4)(g)), the EB Regulation does not establish a timeline for the NRA to reach a decision.

Svenska kraftnät is responsible for ensuring that there is enough balancing capacity at all times. Shortage situations should therefore only occur sporadically why it cannot be reasonable to expect that a shortage pricing mechanism will replace the BRP fee, which is in the vicinity of 2 billion SEK.

The EB Regulation's preference for a shortage pricing function also makes it difficult to set up the right incentives as the fee is directed at BRPs, but it is the BSPs that offer balancing capacity to the TSO.

Discussion and views

There are different ways to comply with article 44.

Svenska kraftnät recommends that in order to ensure its financial neutrality, a balance responsibility fee (an additional settlement mechanism) continues to be levied on balance responsible parties.

In order to cover costs associated with imbalance flows between bidding zones, up- and downregulations during the same hour and "quarter-hour trades" (kvartsaffärer) once the income from production imbalances disappears, Svenska kraftnät recommends that also these costs are included in the additional imbalance settlement mechanism. However, these costs concern balancing energy and thus fall under article 44(2) which requires that such costs are passed on to network users. Consequently, NRAs may not approve of such an arrangement. If these costs are to be recovered through the imbalance settlement, an additional component in the imbalance price will need to be used.

Svenska kraftnät's guiding principles for a future fee structure are that the fee:

> ensures the recovery of Svenska kraftnät's costs.

> is simple, predictable and robust.

> does not distort competition.

> is cost-correct, i.e. the costs caused by a balance responsible party shall be borne by that balance responsible party (polluter pays principle).

> provide correct incentives.

Swedish market participants broadly support a fee that is simple, fair and cost-correct. The same fee should be applied to generation and demand. The fee should have two components, a component for costs that are socialised (basic fee) and a component that BRPs can influence by keeping balance (imbalance fee). Swedish market participants have also

pointed out the importance of Nordic harmonization and have expressed a desire to have a harmonised fee structure as is the case today.