Methodological paper:

Benefits from balancing market integration (imbalance netting and exchange of balancing energy)

This methodological paper has been reviewed in detail and assessed to be “adequate” and “robust” by an external expert.

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Content

1. Introduction

(1) This document is one of a set of documents describing various methodologies applied in the electricity wholesale markets volume of the annual ACER/CEER Market Monitoring Report (MMR), which is intended to present the results of the monitoring of the performance of the internal electricity market in the European Union (EU).

(2) This paper is aimed at describing methodologies used to compute gross short-term benefits (without assessing the incurred costs or long-term benefits) from the exchange of balancing services, with a focus on the benefits derived from imbalance netting and the cross-zonal exchange of balancing energy.

2. General approach

(3) Sharing balancing capabilities among TSOs may lead to increased reliability levels at lower costs: risks and remedial actions could be shared. Balancing resources may be shared on the basis of three main mechanisms

1. In (close to) real-time, imbalances may be netted, or available balancing energy may be exchanged between TSOs (provided that remaining cross-zonal capacity is available) in a similar way as for day-ahead (DA) and intraday (ID) markets.

2. Required reserve levels may be set at a national level[1], but balancing capacity may be exchanged (jointly with cross-zonal capacity for reserves purposes)

3. Reserves may be shared, i.e. set, procured and activated at European level (jointly with cross-zonal capacity for reserves purposes)

(4) For the first mechanism (exchange of balancing energy, including imbalance netting), the benefits are twofold: first, as for DA/ID markets, when remaining cross-zonal capacity is available, cheaper cross-zonal balancing orders may be activated; furthermore, balancing needs may be netted among TSOs, avoiding unnecessary activations[2].

(5) For the second mechanism (exchange of balancing capacity), the benefit comes from the procurement of cheaper balancing capacity from neighbouring countries (jointly with cross-zonal capacity reservation, ensuring that the reserve power may be imported/exported when needed). Exchanging balancing capacity ensures cheaper reserve procurement costs at European level (for the same overall reserve level) by relying on cheaper units. However, this benefit triggers a market welfare loss in DA and/or ID, because any MW reserved for procurement of balancing capacity cannot be used later for market purposes[3]. As a result, this benefit should be computed as the difference between the savings on reserve procurement costs and the loss of market welfare.

(6) For the third mechanism (reserves sharing), reserve levels are both set and procured at the regional level (or European level) jointly with cross-zonal reserve capacity procurement. The frequency containment reserve is currently handled in this way in Continental Europe[4]. Assessing reserve needs at regional level ensures benefits in addition to the exchange of balancing capacity: regional

[1] Based on regional or European guidelines

[2] However, the netting process leads to 'implicit' cross-zonal balancing exchange (e.g. the long area would still generate more energy to compensate for the short area imbalance).

[3] The resulting loss per MW is likely to be equivalent to the market price spread on the considered border

[4] FCR exchanges in Continental Europe are ensured using transmission reliability margins on network elements. Some limitations apply to the procurement of FCR, to ensure that flow deviations coming from FCR activations do not go beyond transmission reliability margins on network elements.

reserve levels would usually be (much) lower than the sum of scheduling areas' reserve levels, because risks would be shared over a wider geographical area[5]. This benefit also triggers a market loss (in a similar way as for the second mechanism); it should be computed by comparing savings in reserves costs with market welfare losses.

(7) The second and third mechanisms are currently beyond the scope of the MMR, so the calculation process focuses on the first mechanism.

3. Calculation process

(8) The efficiency of cross-zonal exchange of balancing energy (including imbalance netting) may be defined for a given set of scheduling area borders as

$$\frac{\sum_{borders\ and\ hours} netted\ imbalance\ energy(h) + exchanged\ balancing\ energy(h)}{\sum_{borders\ and\ hours} potential\ netted\ imbalance\ energy(h) + \min\left(ATC_{balancing}(h), imbalance(h), available\ balancing\ reserve_{long}, available\ balancing\ reserve_{short}\right)}$$

(9) where $ATC_{balancing}$ is the capacity that remains available for balancing after the intraday timeframe, and the imbalance refers to the imbalance of the scheduling areas with the more costly activation of balancing energy[6]. The available balancing reserves in the relevant scheduling areas are computed as follows. The maximum balancing energy activated during a market time unit in the preceding year is assumed to describe the maximum available balancing energy. For a given market time unit, the available balancing reserve is then the difference between this cap and the already activated reserves.

(10) In order to estimate potential welfare gains, priority is given to imbalance netting (i.e. until its potential is exhausted). Potential savings from exchanging balancing energy are then estimated based on the remaining imbalance. The potential welfare gains from imbalance netting may be computed[7] as follows (separately for each border)

1. There is a netting potential for a given border and market time unit when
    a. The two neighbouring scheduling areas display opposite imbalances
    b. Remaining cross-zonal capacity is available from the scheduling area with surplus energy ("long scheduling area") to the scheduling area with energy shortage ("short scheduling area")
    c. The downward balancing energy price in the long scheduling area is lower than the upward balancing energy price in the short scheduling area (netting price spread > 0)[8]
2. The netted energy is the minimum of
    a. The remaining cross-zonal capacity between the long and short scheduling areas
    b. The minimum imbalance of the long and short scheduling areas
3. The netted energy value is then

[5] For example, for FCR, each individual reserve level would probably be close to the current regional level, because this reserve is designed to handle the simultaneous loss of the largest two generating units in the region (and generating units' sizes are more or less homogeneous throughout Europe).

[6] The more costly activation of balancing energy refers to the more expensive (respectively cheaper) balancing offers when activating balancing upward (downward).

[7] A regional project (named iGCC) operating imbalance netting between 11 TSOs in 8 countries is described at https://www.entsoe.eu/Documents/Network%20codes%20documents/Implementation/IGCC/20161020_IGCC_Stakeholder_document.pdf.

[8] I.e., no gain is to be expected from activating both a downward offer in the long country and an upward offer in the short country.

$$netted\ imbalance_{value} = energy_{netted} * (balancing\ energy\ price\ up_{short\ control\ area} - balancing\ energy\ price\ down_{long\ conrol\ area})$$

(11) The overall imbalance netting benefit is then the sum of individual borders netting benefits.

(12) The potential welfare gains from the exchange of balancing energy can then be computed based on the remaining imbalance (and cross-zonal capacity) after netting. The potential cross-zonal benefit of balancing energy exchange is computed in a similar way as DA/ID welfare gains[9], i.e. by combining remaining available cross-zonal capacity, remaining imbalance, available reserves and downward/upward balancing energy prices as follows

$$potential\ balancing\ energy_{value} = \min\left(ATC_{balancing\ after\ netting}, imbalance, available\ balancing\ reserve_{long}, available\ balancing\ reserve_{short}\right) * balancing\ price_{spread}$$

(13) where the available balancing reserves are computed as above. The balancing price spread is derived from up and down balancing prices in the relevant scheduling areas.

(14) The actual gains from the application of imbalance netting and the exchange of balancing energy can be computed by assuming that these gains are proportional to the ratio between actual and potential exchanges, i.e. the efficiency ratio calculated above is combined with the potential gains.

4. Caveats

(15) When applying the aforementioned methodology for estimating benefits from the exchange of balancing energy plus imbalance netting, the following caveats and considerations apply:

- The potential benefits are computed separately for each border: as a result, a given imbalance in a country may be netted or imported multiple times (for multiple separate borders A-B and A-C), potentially leading to an overestimate of the potential.

- Estimates are computed relying on imbalance data (and processes) based on different time granularities (because imbalance settlement periods (ISPs) are not homogeneously set in Europe). To facilitate the calculation process across borders with different ISPs, the data is adapted, assuming that all ISPs are set to 15 minutes. This assumes that all variables (imbalances, prices, cross-zonal capacity, etc.) defined for ISPs longer than 15 minutes remain constant within the ISP.

- Imbalances within an ISP are ignored[10], whereas imbalance netting may be applied in real time to solve such imbalances. This simplification alters the results of the potential for imbalance netting (which is underestimated) and the potential for the exchange of balancing energy.

- For a given market time unit and balancing market, balancing energy prices are assumed to remain constant when the activated balancing energy changes (through exchange of balancing energy). This assumption may lead to an overestimate of the potential savings.

- When detailed data (i.e. per market time unit) on actual exchanges are not available, the actual gain is approximated by considering yearly average exchanges. However, estimated potential exchanges and estimated potential gains are calculated on a per market time unit basis.

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[9] See the methodological paper on 'Benefits from day-ahead and intraday market coupling' available at: https://www.acer.europa.eu/en/Electricity/Market%20monitoring/Documents_Public/ACER%20Methodological%20paper%20-%20Benefits%20from%20day-ahead%20and%20intraday%20market%20coupling.pdf.

[10] Such detailed data are currently not available to the Agency

- When information is not available for all borders, extrapolation at European level is computed proportionally to average NTC values.

5. Data

Table 1: Data required and sources used for the welfare analysis on the benefits from balancing markets integration

Description	Unit	Time granularity	Geographic granularity	Source
Average/marginal balancing energy price (up and down)	euros/MWh	Market time unit	Scheduling area	ENTSO-E TP
Netted imbalance power	MW	ISP	Scheduling area	NRAs
Activated balancing power	MW	Market time unit	Scheduling area	ENTSO-E TP
Average imbalance	MW	ISP	Scheduling area	NRAs
Available cross-zonal capacity at time of balancing	MW	Market time unit	Border-direction	NRAs
Exchange of balancing energy	MW	Market time unit	Border between scheduling areas	NRAs