Annex
Imbalance Energy Management
(T&C - BGC)

V 00.20

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Document Management

Document History

Version	Status	Date	Supervisor	Reason for Amendment
1.00	Approved	13 Sept. 2001	E-Control	Annex to Official Notice of 13 Sept. 2001, ZI. G BKA 02/01
2.00	Approved	26.11.2001	E-Control	Amendment "market close"
3.00	Approved	26 March 2002	E-Control	Amendment "intervals in time blocks, market makers"
4.00	Approved	18 Sept. 2002	E-Control	Change to UCTE schedule
5.00	Approved	20.12.2002	E-Control	Introduction of subsequent settlement, 2nd clearing
6.00	Approved	30 Sept. 2003	E-Control	Consideration of UCTE holiday rules
7.00	Approved	17 Feb. 2004	E-Control	Prolongation T&C-BGC, aFRR balancing energy procurement through a power exchange, math. formula (Annex to Official Notice of 17 February 2004)
8.00	Approved	4 Oct. 2004	E-Control	Market makers, time blocks minute reserves
9.00	Approved	15 March 2005	E-Control	New pricing model, clearing price calculation
10.00	Approved	14 Nov. 2007	E-Control	Changes to subsequent settlement and related schedules
11.00	Approved	20 April 2009	E-Control	Change to aFRR redelivery period
12.00	Approved	22 July 2009	E-Control	Spread resulting from an aFRR redelivery programme through a power exchange
13.00				Combining of control areas
14.00	Approved	21 Dec. 2011	E-Control	Annex to Official Notice of 21 December 2011
15.00	Approved	8 April 2015	E-Control	Cross-border balancing energy settlement
16.00	Approved		E-Control	Adjustments to pricing model and cross-border balancing energy settlement
17.00	Approved	5 Oct. 2017	E-Control	Risk management
18.00	Approved	6 Dec. 2018	E-Control	GLEB also EB GL (Guideline on Electricity Balancing)

19.00	Approved	7 May 2021	E-Control	Imbalance Energy Model 2021 (AEP Modell)
00.20	Submitted	2 Feb. 2022	APCS	Schedule ramping and platforms

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1 Scope and Definition of Balancing Energy versus Imbalance Energy

The provisions set out below describe the organisation of the management of imbalance energy.

To clearly differentiate between balancing energy and imbalance energy, the control area manager (CAM) sets up special balance groups for the separate registration of manual frequency restoration reserves (mFRR) and automatic frequency restoration reserves (aFRR) actually used by suppliers of balancing energy, and the unavoidable and unintended exchange of energy with other grids of the European grid network per settlement period (1/4h) due to the technical requirements and measurement limitations.

2 Balancing

The CAM determines the capacity bandwidth required to offset the imbalances expected in the sum of the balance groups (BG) between generation and consumption in the control area so as to make it possible to comply at all times with the technical rules for frequency containment, automatic frequency restoration and active power control.

The balance group coordinator (BGC) uses components that record the amounts purchased per provider and direction for the settlement of the quantities of balancing energy. Balancing energy providers register with control area managers. The control area managers send the master data to the BGC for use as a basis for setting up the components.

Balancing within a control area involves three balancing energy components:

1) Automatic frequency restoration reserves
2) Manual frequency restoration reserves
3) Unintended energy exchange

The technical rules defined for the unintended exchange of energy with other control areas state that the volume determined within one week (Mon 0:00 hrs to Sun 24.00 hrs) must be measured by tariff period and balanced in the subsequent week under a compensation programme as a delivery within the corresponding bandwidth in the respective tariff period. The energy volumes made available for this purpose are either procured by international tenders or on electricity exchanges.

3 Disclosure Obligations and Transparency

The BGC is under the obligation to make information available to ensure a transparent, non-discriminatory balancing energy market that is as liquid as possible pursuant to § 23 (5) 5 Electricity Industry and Organization Act (Elektrizitätswirtschafts- und –organisationsgesetz, EIWOG) in conjunction with Article 3 (1) a, EBGL (Guideline on Electricity Balancing).

The basis for being able to comply with the obligation to ensure supply security and transparency is the transmission of CAM auction data to the BGC.

The CAM informs the BGC of the balancing of the frequency containment reserve, manual frequency restoration reserve and automatic frequency restoration reserve broken down by power supply and demand. The BGC publishes the capacity bandwidths of the balancing energy components defined by the CAM to inform market participants.

As soon as the tender procedures are completed for energy quantities and capacities regarding balancing energy components, unintended energy exchange, frequency containment reserve capacity, automatic frequency restoration reserves capacity, automatic frequency restoration reserve energy, manual frequency restoration reserve energy and the bids have been awarded, are the quantities offered and accepted, the offer prices per bidder and the bids sent to the BGC by the CAM.

Information on the energy volumes purchased per bidder and bid as well as the offers classified as "not available" are sent by the CAM to the BGC on the next day.

The BGC publishes the volumes and prices of the bids as well as the volumes and prices awarded in anonymized form in accordance with § 23 (5) 5 EIWOG.

The BGC will make available to every balancing energy provider their personal bids submitted, awarded and called during the auction procedure. The aim is to offer the balancing energy provider a view of its balancing energy bids together with related balancing data within one system so as to create a "single point of information". For this purpose, the control area manager is under the obligation to transmit the data to the BGC in a non-anonymous format.

The preliminary aggregated system imbalance determined in quarter-hour intervals is transmitted immediately by the CAM to the BGC for risk management by the BGC and market participants.

4 Technical Clearing

"Technical Clearing" refers to data transfer, "First Clearing", "Second Clearing" and any subsequent settlement.

4.1 Data received

Data received per clearing period includes:

- from BGR: internal schedules separated by purchase and delivery

- from TSO: internal schedules separated by purchase and delivery
- from CAM: purchase schedules for each balancing energy component broken down by provider as well as purchase and delivery
- from GO**:** the sum of aggregated load profile metering values (time series of quarter-hour values) and aggregated synthetic load profiles, separated by generation and consumption, by supplier and balance group as well as the time-series of the grid coupling points whose data are the responsibility of the GO.

The BGC determines the volume of imbalance energy based exclusively on the schedule values made available by the BGR, CAM and TSO and assigned to the respective BG, as well as on the respective aggregated quantity of the time-series of actual quarter-hour values in kWh assigned to the BG by the network operator and the load profile per network operator and BG, separated by feed-in and purchase.

Furthermore, for every BG, the BGC introduces an additional settlement volume for each quarter-hour based on the schedule balance and the metered values of the generation and consumption units. The method of calculation of these additional settlement quantities is defined in 4.2.

4.2 Incentive method for a linear change in capacity of generation and consumption units

The reason for introducing this method was the increased frequency of short-lived deviations in balancing energy in the APG Control Area during the quarter-hour transition caused by rapid changes in capacities at the generation plants that are often the main reason for deviations from target values in grid frequency.

Implementation in clearing is done exclusively by volume shifts based on the schedule balance for the settlement of imbalance energy. The schedules the BGR sends to the BGC for the exchange with other balance groups are not affected by this, which is why no corrections are required from the BGR in this regard. For every balance group to which either generation and/or consumption metering values are assigned within a quarter-hour, this shift in quantity is done by the BGC by ramping schedule balance values of the adjacent quarter-hours, which, in addition to the current quarter-hour t, also affects the previous quarter-hour $t-1$ and the subsequent quarter hour $t+1$ t.

For the calculation of the shift in volume, the BGC first calculates the schedule balance for each quarter-hour and for each BG based on the schedules sent by the BGR. In a next step, a linear transition is construed from the corresponding schedule values, which starts five minutes before the end of the quarter-hour and changes over to the following value five minutes after the beginning of the next quarter-hour. For the calculation of the imbalance energy, the schedule balance adjusted by the resulting shift in volume is compared with the balance of the metered values for generation and consumption.

When the real change in capacity of the balance groups is also ramped accordingly (see shaded areas in Figure 1), no additional imbalance energy is generated by the volume shifting procedure for schedule values. In the case of a "block-shaped" sum of capacity changes in the generation and consumption units of the balance groups according to the schedule sent by the BGR, these would be debited against imbalance energy to the extent of the volume shift.

$E_{FPS_{b,t}}$. . . Volume of the schedule balance (excl. balancing energy) of the balance group b in the quarter-hour t

$E_{RA_{b,t}}$ . . . Additional volume for so-called ramping for the balance group b in the quarter-hour t

$$E_{RA_{b,t}} := \frac{1}{12}\left(E_{FPS_{b,t+1}} + E_{FPS_{b,t-1}} - 2 \cdot E_{FPS_{b,t}}\right)$$

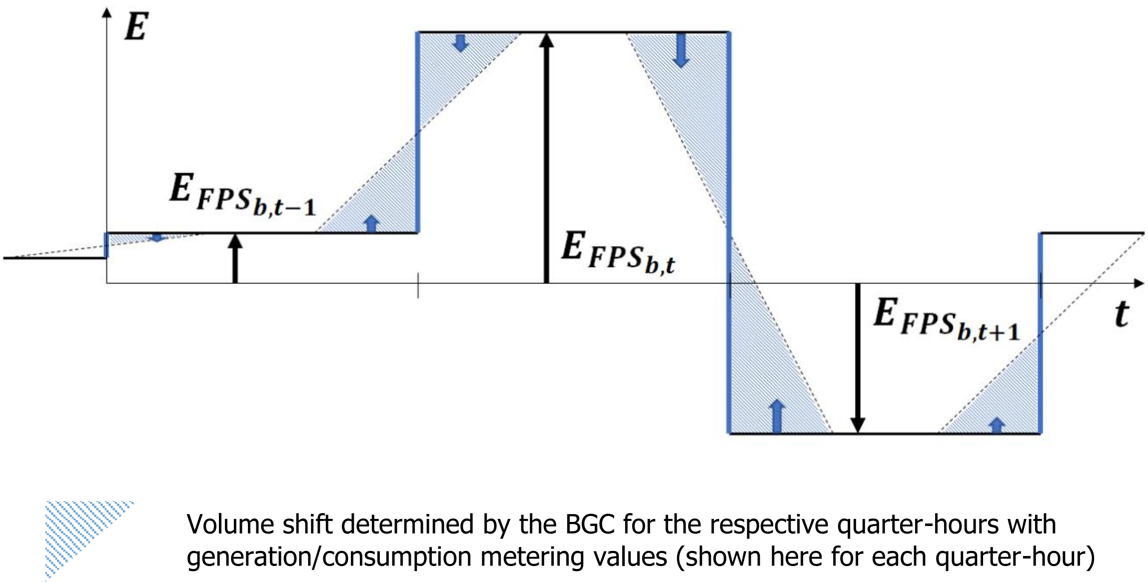
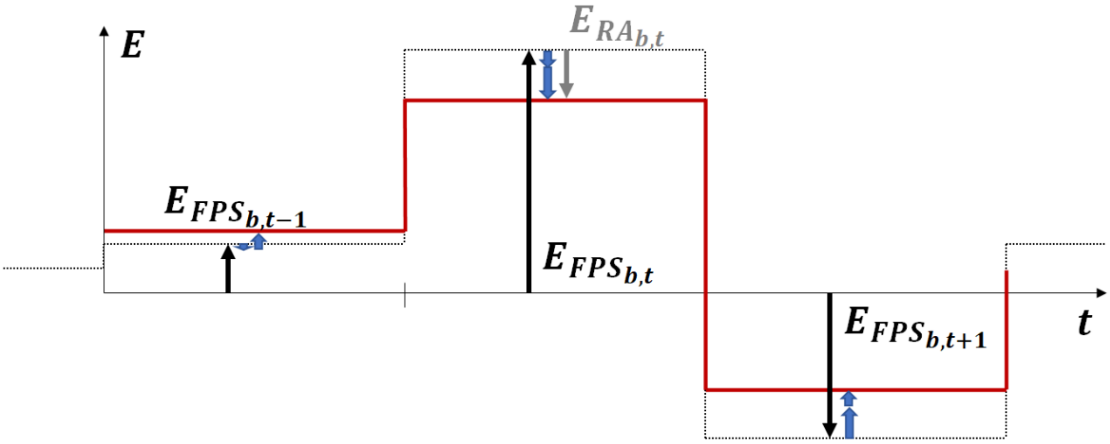


Figure 1: Determination of the volume shift by the BGC



…………	The netted volume of the schedule sent by the BGR (excluding volume adjustment for imbalance energy calculation, does not change for the exchange with other balance groups)
———	The netted volume of the schedule after accounting for volume adjustment for the calculation of imbalance energy

Figure 2: Effect of the volume adjustment on the calculation of imbalance energy

4.3 First clearing

First clearing takes place on a monthly basis and is the process during which quarter-hourly imbalance energy for each BG is determined by netting the aggregate values of the schedules and the sum of the aggregate metered values (time-series of quarter-hour values) as well as determining the aggregated synthetic load profiles in accordance with the preliminary consumption values.

The data is supplied by the GO to the BGC within 8 (eight) workdays as of the last day of the month to which the data applies. Should the BGC request missing or incorrect data retroactively, the grid operators must provide the data within 2 (two) further workdays.

4.4 Subsequent settlement

Subsequent settlement can only be done within six months after completion of the “first clearing” for single months and single BGs upon request of the concerned BGRs and serves to correct volumes in the event of the faulty quality of the basic data (aggregated metered values). Apart from the metering values, internal schedules can also be adjusted during subsequent settlement if one of the two market participants concerned ("data controller") requests APCS to do so, and the second market participant concerned agrees to this change in writing (fax) within two workdays.

The BGC has the right to charge the BGR, at whose request the subsequent settlement is carried out, an additional fee for the subsequent settlement commensurate with the expenses incurred.

4.5 Second clearing

As in the "first clearing", the **second clearing** takes place on a monthly basis, but for the respective 15th preceding month and takes into account the actual energy metering volumes. In addition, any open volume corrections from the "first clearing" (e.g. substitute values, retroactive customer switch, changes resulting from switching dates) are also taken into account in the "second clearing".

At the latest on the last workday of the current month, the data of the 14th preceding month must be supplied to the BGC for the designated data areas. The same metering point and component designations must be used for both the second clearing and the first clearing.

The clearing calendar published on the APCS website is valid for the close of clearing for the second clearing. After the close of clearing, market participants have a period of time to review their data specified as the "quality-review-until" date in the clearing calendar. It is not possible to change the data after this cut-off date.

A **retroactive change to schedules** (including grid loss schedules) is not permitted during the second clearing. The entire clearing process is completed with the second clearing. Therefore, no subsequent settlement is permitted for the second clearing.

5 Settlement of Imbalance Energy

The invoicing of imbalance energy to the BGR is based on the imbalance energy price for the volume of imbalance energy calculated pursuant to Clause 4 (energy delivery pursuant to the Austrian VAT Act).

The imbalance energy price is calculated per quarter-hour and is the same as for imbalance energy delivered or withdrawn.

5.1 Process for calculating the price of imbalance energy

Where V_t is the (aggregated) system imbalance (minus or plus) in a quarter-hour, t is capacity.

V_t indicates how much capacity in the control area is delivered or purchased on average by automatic frequency restoration, manual frequency restoration and the unintentional energy exchange as a result of the frequency containment process.

V_t is positive when on average the balancing capacity had to be fed into the system, and negative when it had to be returned from the system.

5.1.1 Calculation of the price of balancing energy

When determining the imbalance energy price, in a first step, a price for balancing energy for positive and negative deviations per quarter-hour t is determined.

5.1.1.1 Calculation of the volume-weighted price for aFRR balancing energy

The volume-weighted average prices as well as the volume of activated aFRR balancing energy are made available to the BGC by the CAM.

The data is calculated by the CAM separately for positive and negative activation. The calculation considers all activations required to maintain a capacity balance within the APG control area. This includes bids in third-party control areas that have been activated for the APG control area. Bids activated in the APG control area but intended for a third-party control area are excluded from the calculation.

As soon as the CAM exchanges aFRR balancing energy through the platform pursuant to Art 21 EBGL, the volume-weighted average price of the aFRR balancing energy used for the calculation of the imbalance energy price for a settlement-relevant quarter-hour shall be calculated based on the prices determined by the optimization function of the platform pursuant to Article 9 (3c) ISHM (Imbalance Settlement Harmonisation Methodology) and the quantities pursuant to Article 9 (5c) ISHM.

Should no data be available for the individual quarter-hour settlement or parts of a quarter-hour settlement, the locally determined withdrawal prices and quantities are used.

5.1.1.2 Calculation of the volume-weighted price for mFRR balancing energy

The volume-weighted average prices as well as the volume of activated mFRR balancing energy are made available to the BGC by the CAM.

The CAM calculates the data separately for positive and negative activation. The calculation considers all activations required to maintain capacity balance within the APG control area. This includes bids in third-party control areas that have been activated for the APG control area. Bids activated in the APG control area but intended for a third-party control area are excluded from the calculation.

As soon as the CAM exchanges mFRR balancing energy through the platform pursuant to Art 20 EBGL, the volume-weighted average price of the mFRR balancing energy used for the calculation of the imbalance energy price for a settlement-relevant quarter-hour shall be calculated using the prices determined by the optimization function of the platform pursuant to Article 9 (3b) ISHM and volumes pursuant to Article 9 (5b) ISHM.

Should no data be available for the individual quarter-hour settlement or parts of a quarter-hour settlement, locally determined purchase prices and volumes are used.

5.1.1.3 Calculation of the volume-weighted price for balancing energy

For a "quarter-hour interval" $t,$ the following values apply:

$P_{SREpos,t}$ . . . Average price of activated positive aFRR balancing energy in a quarter-hour t

$P_{TREpos,t}$ . . . Average price of activated positive mFRR balancing energy in a quarter-hour t

$P_{SREneg,t}$ . . . Average price of activated negative aFRR balancing energy in the quarter-hour t

$P_{TREneg,t}$ . . . Average price of activated negative mFRR balancing energy in a quarter-hour t

$E_{SREpos,t}$ . . . Price of activated positive aFRR balancing energy in a quarter-hour t

$E_{TREpos,t}$ . . . Average price of activated positive mFRR balancing energy in a quarter-hour t

$E_{SREneg,t}$ . . . Average price of activated negative aFRR balancing energy in a quarter-hour t

$E_{TREneg,t}$ . . . Average price of activated negative mFRR balancing energy in a quarter-hour t

$P_{SREposMOL,t}$ . . . Lowest price of the local positive aFRR balancing energy merit order list in a quarter-hour t

$P_{SREnegMOL,t}$ . . . Highest price of the local negative aFRR balancing energy merit order list in a quarter-hour t

5.1.1.4 Calculation of the positive price for balancing energy

The volume-weighted average price for positive balancing energy $P_{REposAct,t}$ in the "quarter-hour interval" t is calculated as:

$$P_{REposAct_{,t}} \coloneqq \frac{E_{SREpos_{,t}} \cdot P_{SREpos_{,t}} + E_{TREpos_{,t}} \cdot P_{TREpos_{,t}}}{E_{SREpos_{,t}} + E_{TREpos_{,t}}}$$

5.1.1.5 Calculation of the negative price for balancing energy

The volume-weighted average price for negative balancing energy $P_{REnegAct_{,t}}$ in the "quarter-hour interval" t is calculated as:

$$P_{REnegAct_{,t}} \coloneqq \frac{E_{SREneg_{,t}} \cdot P_{SREneg_{,t}} + E_{TREneg_{,t}} \cdot P_{TREneg_{,t}}}{E_{SREneg_{,t}} + E_{TREneg_{,t}}}$$

5.1.1.6 Calculation of the value of avoided activation

If there are no activations in the relevant direction of aFRR balancing energy or mFRR balancing energy in a quarter-hour t, the value of the avoided activation (VoAA) is calculated to determine a balancing energy price.

The value of avoided activation is determined by the lowest or highest price on the local merit order lists for positive or negative aFRR balancing energy.

$$P_{VoAA,pos_{,t}} \coloneqq P_{SREposMOL_{,t}}$$

$$P_{VoAA,neg_{,t}} \coloneqq P_{SREnegMOL_{,t}}$$

5.1.1.7 Calculation of the balancing energy price

In the case of activation of aFRR or mFRR balancing energy, the price of the balancing energy in the quarter-hour t is the quantity-weighted price of the activated balancing energy.

If there are no activations of aFRR or mFRR balancing energy in a quarter-hour, the value of the avoided activation determines the balancing energy price.

First, positive and negative balancing energy is defined as the sum of positive and negative aFRR and mFRR balancing energy, respectively, to differentiate by activation.

$$E_{REpos_t} \coloneqq E_{SREpos_t} + E_{TREpos_t}$$
$$E_{REneg_t} \coloneqq E_{SREneg_t} + E_{TREneg_t}$$

If neither positive nor negative balancing energy is activated in the quarter-hour$t$, the balancing energy component shall be determined based on the value of the avoided activation in the relevant direction. V_t

If only positive or negative balancing energy is activated in the quarter-hour, $t$the balancing energy component must be determined on the basis of the activated positive or negative balancing energy.

If only positive or negative balancing energy is activated in the quarter-hour t, the balancing energy component must be determined on the basis of the activated positive or negative balancing energy V_t. The relevant direction is determined pursuant to 5.1.

$$P_{RE,t} \coloneqq \begin{cases} P_{VoAA,neg_t}, & (E_{REpos_t} = 0) \coloneqq (E_{REneg_t} = 0) \coloneqq (V_t < 0) \\ P_{VoAA,pos_t}, & (E_{REpos_t} = 0) \coloneqq (E_{REneg_t} = 0) \coloneqq (V_t \geq 0) \\ P_{REposAct_{,t}}, & (E_{REpos_t} > 0) \coloneqq (E_{REneg_t} = 0) \\ P_{REnegAct_t}, & (E_{REpos_t} = 0) \coloneqq (E_{REneg_t} > 0) \\ P_{REnegAct_t}, & (E_{REpos_t} > 0) \coloneqq (E_{REneg_t} > 0) \coloneqq (V_t < 0) \\ P_{REposAct_t}, & (E_{REpos_t} > 0) \coloneqq (E_{REneg_t} > 0) \coloneqq (V_t \geq 0) \end{cases}$$

For a presentation of the definition of $P_{RE,t}$, see the logical truth table, Table 1, which uses colour-coding to explain it.

Table 1: Definition of $P_{RE,t}$ using a truth table

$E_{REpos_t} > 0$	$E_{REneg_t} > 0$	$V_t \geq 0$	$P_{RE,t}$
FALSE	FALSE	FALSE	P_{VoAA,neg_t}
FALSE	FALSE	TRUE	P_{VoAA,pos_t}
FALSE	TRUE	FALSE	$P_{REnegAct_t}$
FALSE	TRUE	TRUE	$P_{REnegAct_t}$
TRUE	FALSE	FALSE	$P_{REposAct_t}$

TRUE	FALSE	TRUE	$P_{REposAct,t}$
TRUE	TRUE	FALSE	$P_{REnegAct,t}$
TRUE	TRUE	TRUE	$P_{REposAct,t}$

5.1.2 Coupling with exchange prices

To avoid incentives detrimental to the system, several exchange price indices are taken into consideration when calculating the imbalance energy price. The exchange price indices are provided by the NEMOs operating in the Austrian market area.

Generally, spot market prices are used for the calculation.

The FCR price P_{ID15} is determined on the price indices of the intraday market for 15-minute products provided by the NEMO, which include all trades executed in the last three hours before the start of delivery.

The aFRR price $P_{ID60}$is determined from the price indices of the intraday market for 60-minute products provided by the NEMO, which include all trades executed in the last three hours before the start of delivery.

The mFRR price $P_{DA}$is the hourly day-ahead spot market price (market coupling price) of the NEMO.

The price indices are weighted according to the volume of trades pursuant to Clause 5.1.2.1.

To avoid unsuitable price signals from individual market time slots with insufficient liquidity, the prices of the intraday market P_{ID15} and P_{ID60} are volume-weighted with the day-ahead exchange price P_{DA} when volumes fall short of thresholds.

The hourly prices and the hourly trading volume in MWh/h apply to all quarter-hours t of the respective hour.

The prices of the Austrian price zone apply in each case.

Subsequent changes to the day-ahead exchange price P_{DA} and the intraday exchange prices P_{ID15} and P_{ID60} are taken into account in the period settlement, provided the changes are announced within the data period defined for the respective settlement. Changes in the day-ahead exchange price P_{DA} and the intraday exchange prices P_{ID15} and P_{ID60} are generally not taken into account in subsequent settlements or in the final settlement.

5.1.2.1 Calculation of the exchange price index

In a first step, the price indices provided by NEMO are weighted according to the capacity volume L of the trades. The capacity volumes, $L_{ID15_{\alpha,t}}$and $L_{DA_{\alpha,t}}$are calculated $L_{ID60_{\alpha,t}}$using the average of the buy and sell trades of the respective market area and NEMO a. The volume M_{NEMO}consists of all NEMOs operating in the Austrian market area and the variable a, therefore, the sum index for prices and volumes of NEMOs.

$$L_{ID15_{,t}} := \sum_{\alpha \epsilon M_{NEMO}} L_{ID15_{\alpha,t}}$$

$$L_{ID60_{,t}} := \sum_{\alpha \epsilon M_{NEMO}} L_{ID60_{\alpha,t}}$$

$$L_{DA_{,t}} := \sum_{\alpha \epsilon M_{NEMO}} L_{DA_{\alpha,t}}$$

$$P_{ID15_{,t}} := \begin{cases} \frac{1}{L_{ID15_{,t}}} \cdot \sum_{\alpha \epsilon M_{NEMO}} (P_{ID15_{\alpha,t}} \cdot L_{ID15_{\alpha,t}}), L_{ID15_{,t}} > 0 \\ nicht\ definiert, \qquad L_{ID15_{,t}} = 0 \end{cases}$$

$$P_{ID60_{,t}} := \begin{cases} \frac{1}{L_{ID60_{,t}}} \cdot \sum_{\alpha \epsilon M_{NEMO}} (P_{ID60_{\alpha,t}} \cdot L_{ID60_{\alpha,t}}), L_{ID60_{,t}} > 0 \\ nicht\ definiert, \qquad L_{ID60_{,t}} = 0 \end{cases}$$

$$P_{DA_{,t}} := \begin{cases} \frac{1}{L_{DA_{,t}}} \cdot \sum_{\alpha \epsilon M_{NEMO}} (P_{DA_{\alpha,t}} \cdot L_{DA_{\alpha,t}}), L_{DA_{,t}} > 0 \\ nicht\ definiert, \qquad L_{DA_{,t}} = 0 \end{cases}$$

Moreover, product-specific markups and markdowns on the exchange price indices given above are defined. The markups and markdowns are calculated on the maximum of the absolute and percentage markups and markdowns. The absolute markups and markdowns are given in the Annex.

To avoid large jumps in exchange price indices when the system imbalance passes close to zero, the prices are corrected for absolute deviations smaller than the capacity threshold value L_{rampe} by a linear function ("ramp"), depending on V_t.

$$P_{ID15,marked_{,t}} := \begin{cases} P_{ID15_{,t}} + \operatorname{sgn}(V_t) \cdot \max\left(P_{ID15,mark}, \frac{1}{10} \cdot \operatorname{abs}(P_{ID15_{,t}})\right), abs(V_t) > L_{rampe} \\ P_{ID15_{,t}} + \frac{V_t}{L_{rampe}} \cdot \max\left(P_{ID15,mark}, \frac{1}{10} \cdot \operatorname{abs}(P_{ID15_{,t}})\right), abs(V_t) \leq L_{rampe} \end{cases}$$

$$P_{ID60,marked_{,t}} \coloneqq \begin{cases} P_{ID60_{,t}} + \operatorname{sgn}(V_t) \cdot \max\left(P_{ID60,mark}, \frac{1}{10} \cdot \operatorname{abs}(P_{ID60_{,t}})\right), abs(V_t) > L_{rampe} \\ P_{ID60_{,t}} + \frac{V_t}{L_{rampe}} \cdot \max\left(P_{ID60,mark}, \frac{1}{10} \cdot \operatorname{abs}(P_{ID60_{,t}})\right), abs(V_t) \leq L_{rampe} \end{cases}$$

$$P_{DA,marked_{,t}} \coloneqq \begin{cases} P_{DA_{,t}} + \operatorname{sgn}(V_t) \cdot \max\left(P_{DA,mark}, \frac{1}{10} \cdot \operatorname{abs}(P_{DA_{,t}})\right), abs(V_t) > L_{rampe} \\ P_{DA_{,t}} + \frac{V_t}{L_{rampe}} \cdot \max\left(P_{DA,mark}, \frac{1}{10} \cdot \operatorname{abs}(P_{DA_{,t}})\right), abs(V_t) \leq L_{rampe} \end{cases}$$

5.1.2.2 Calculation of weighting factors and exchange price index

$$w_{ID15_{,t}} \coloneqq \min\left(1, \frac{L_{ID15_{,t}}}{L_{Schwelle,ID15}}\right)$$

$$w_{ID60_{,t}} \coloneqq \min\left(\left(1 - w_{ID15_{,t}}\right), \frac{L_{ID60_{,t}}}{L_{Schwelle,ID60}}\right)$$

$$w_{DA_{,t}} \coloneqq \left(1 - w_{ID15_{,t}} - w_{ID60_{,t}}\right)$$

The capacity threshold values $L_{Schwelle,ID15}$ and $L_{Schwelle,ID60}$ are given as parameters in the Annex.

The exchange price index $P_{px_{,t}}$ for exchange price coupling is calculated as the weighted sum of the "ramped" exchange price indices.

$$P_{px_{,t}} \coloneqq P_{ID15,marked_{,t}} \cdot w_{ID15_{,t}} + P_{ID60,marked_{,t}} \cdot w_{ID60_{,t}} + P_{DA,marked_{,t}} \cdot w_{DA_{,t}}$$

5.1.3 Calculation of the price of the scarcity function

The price of the scarcity function $P_{knapp,t}$ is derived from the base exchange price index $P_{px_{basis,t}}$ and a third-degree polynomial function, depending on V_t. The polynomial function is valid only within a certain range of V_t. The range is delimited by the deadband L_{tot} and the cap. L_{kapp}

The capacity intersection point $L_{Schnitt}$ and the price intersection point $P_{Schnitt}$ are parameters of the function.

The base exchange price index $P_{px,basis,t}$ is a weighted sum of the ("unramped") exchange indices.

$$P_{px,base,t} = P_{ID15,t} \cdot w_{ID15,t} + P_{ID60,t} \cdot w_{ID60,t} + P_{DA,pos,t} \cdot w_{DA,t}$$

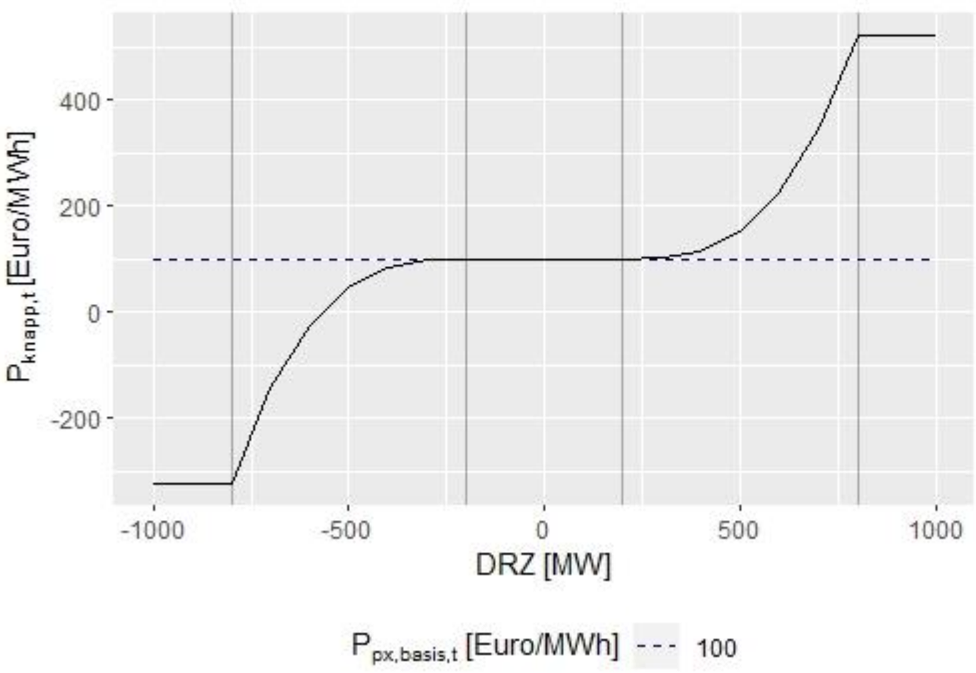


Figure 3 Schematic of the scarcity function

$$P_{knapp,t} := \begin{cases} P_{px,basis,t}, & \text{abs}(V_t) \leq L_{tot} \\ P_{px,basis,t} + \text{sgn}(V_t) \cdot P_{Schnitt} \cdot \left(\dfrac{\text{abs}(V_t) - L_{tot}}{L_{Schnitt} - L_{tot}}\right)^3, & L_{tot} < \text{abs}(V_t) \leq L_{kapp} \\ P_{px,basis,t} + \text{sgn}(V_t) \cdot P_{Schnitt} \cdot \left(\dfrac{L_{kapp} - L_{tot}}{L_{Schnitt} - L_{tot}}\right)^3, & L_{kapp} < \text{abs}(V_t) \end{cases}$$

5.1.4 Calculation of the imbalance energy price

The imbalance energy price $P_{A,t}$ is calculated as

$$P_{A,t} := \begin{cases} \min(P_{RE,t}, P_{px_t}, P_{knapp,t}), V_t < 0, \\ \max(P_{RE,t}, P_{px_t}, P_{knapp,t}), V_t \geq 0, \end{cases}$$

Once all control area deviations for the preceding month and all costs and revenues of the bidding procedures for the preceding month are known, the imbalance energy price is published.

5.1.5 Parameters of the imbalance energy formula

$P_{ID15,mark}$	5 EUR/MWh
$P_{ID60,mark}$	10 EUR/MWh
$P_{DA,mark}$	15 EUR/MWh
$L_{Schwelle,ID15}$	200 MW
$L_{Schwelle,ID60}$	200 MW
L_{tot}	200 MW
L_{kapp}	800 MW
$L_{Schnitt}$	1000 MW
$P_{Schnitt}$	1000 EUR/MWh
L_{rampe}	50 MW

5.1.6 Use of substitute prices

If the final data pursuant to 5.1.1 are not available by the day of the plausibility check defined in the clearing calendar, the BGC has the right to use the exchange price indicator P_{px} pursuant to 5.1.2 instead of the imbalance energy price for the relevant quarter-hours. When the final data becomes available, the BGC will immediately correct the imbalance energy prices in the subsequent settlement.

5.2 Allocation of frequency restoration reserve costs

The revenues from the settlement of imbalance energy are netted against the following costs and revenues for the month:

- Costs and revenues from energy bought and sold by the CAM for mFRR.
- Costs and revenues from energy bought and sold by the CAM for aFRR.
- Costs and revenues from energy bought and sold by the CAM from the unintended exchange of energy (provided the unintended exchange is compensated through the European compensation programme under the European CAM).
- Costs and revenues from the settlement of unintended energy exchange pursuant to EBGL Art. 51 (1) and from the intentional energy exchange resulting from ramping energy and the FCR process pursuant to Electricity Balancing Guideline (EBGL) Art. 50 (3) (effective with entry into force of the European settlement process pursuant to EBGL Art. 51 (1) and EBGL Art. 50 (3))
- Costs and revenues from penalties, retained service fees, and fee cuts for violations of the activation obligation
- Costs and revenues from energy deliveries bought and sold by the CAM for balancing energy components across control areas
- Costs and revenues from corrections to balancing energy components across control areas, provided the corrections refer to settlement periods that do not go back more than three years
- Costs for imbalance energy volumes, which, after termination of the contract by the BGC, were not recovered by the realization of collateral of a market participant. These costs are to be spread over one year in accordance with Electricity Industry and Organization Act (ElWOG) § 77a (4).

Costs and revenues from the settlement of imbalance energy netted against the costs and revenues of the components listed in Clause 5.2 and settled by the BGC and the CAM after the close of the month. In this context, the revenues from the settlement of imbalance energy are used to cover the costs of the aforementioned list. Differences in amount are held in custody by the CAM until a law is passed that regulates their use.

6 Settlement under the Additional Settlement Mechanism mFRR (ZAM)

Costs and revenues for negative capacities purchased under the mFRR (TRL in the formula) system are settled separately from the settlement of imbalance energy through an additional settlement mechanism (ZAM) pursuant to EB GL Art. 44 (3).

For the entire month, the constant price of the ZAM P_{ASM} (in €/MWh) is defined as

$$P_{ASM} \coloneqq \frac{K_{TRL}}{E_{E+V}}$$

where E_{E+V} in this formula is the sum of generation and consumption units of all balance groups in the month and K_{TRL} are the costs of mFRR capacity auctions.

The ZAM price is published after all generation and consumption volumes are available, which is usually after the end of the subsequent data delivery period for the first clearing.

7 Calculation of Additional Components for Mandatory Disclosure pursuant to ISHM

The value of additional components results from the price difference between the exchange price index $P_{px,t}$ and the scarcity function price $P_{knapp,t}$ and the balancing energy price $P_{RE,t}$, when the exchange price index $P_{px,t}$ or the scarcity function price $P_{knapp,t}$ determine the imbalance energy price $P_{A,t}$

$$\Delta P_{px\_RE,t} \coloneqq P_{px,t} - P_{RE,t}$$

$$\Delta P_{knapp\_RE,t} \coloneqq P_{knapp,t} - P_{RE,t}$$

A positive value for a control area with a shortfall $(V_t \geq 0)$ indicates an increase in price; a negative value for a control area with excessive cover $(V_t < 0)$ indicates a lower price. The minimum price pursuant to EBGL Art. 55 (4) to (6) is always complied with.

The value of the incentive component is published by the BGC at the latest on the day the invoice is sent in accordance with the clearing calendar.

8 List of Abbreviations

aFRR	automatic frequency restoration reserves
APG	Austrian Power Grid AG
ASM	Additional Settlement Mechanism
BG	Balance Group
BGC	Balance Group Coordinator
BGR	Balance Group Representative
CAM	Control Area Manager
EB GL	Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline for system balancing in the electricity supply system. Also sometimes abbreviated GLEB.
ElWOG	Elektrizitätswirtschafts- und –organisationsgesetz (Electricity Industry and Organization Act) 2010
EPEX	EPEX SPOT SE
EXAA	EXAA Abwicklungsstellefür Energieprodukte AG
E_{E+V}	Generation and consumption volume of all balance groups in a month
FCR	frequency containment reserve
K_{TRL}	Costs of mFRR capacity per month
mFRR	manual frequency restoration reserves
P_{ZAM}	Price for ZAM for the month
TSO	Transmission System Operator
ZAM	Additional settlement mechanism mFRR (“zusätzlicher Abrechnungsmechanismus für Tertiärregelleistung”)