Calculation of the uniform imbalance price (reBAP) across Germany's 4 control zones

Model description

This english translation is non binding.

Within the framework of the further development of the imbalance price system, this model will be used to implement the stipulation of the Federal Network Agency BK6-12-024 of 25.10.2012, as well as BK6-19-217 of 11.12.2019, BK6-19-552 of 11.05.2020 and BK6-20-345 of 11.05.2021 in terms of imbalance billing, in order to improve the management of balancing groups by the balancing responsible parties (BRPs).

1 Basis of calculation (IP1)

The imbalance price (IP) as a general form of uniform imbalance price (reBAP) is determined in a quarter-hourly time grid. Unless otherwise specified, all values mentioned below refer to a quarter of an hour.

In every quarter of an hour, the total amount of money spent in Germany for the purchase or sale of energy to balance all four control zones of the German Grid Control Cooperation (GCC) (net of costs - revenues) is divided by the net amount of this energy (the GCC net balance position). The GCC net balance position is formed from the positive energy input minus the negative energy input.

$$IP_1 = \frac{\sum Costs_{GCC} - \sum Revenues_{GCC}}{net\ balance\ position_{GCC}} \quad \frac{[EUR]}{[MWh]}$$

As a rule, this energy is procured as balancing energy from contracts with suppliers of aFRR and mFRR, including international cooperation. Furthermore, additional measures can be included in the calculation if necessary, for example if the contracted balancing capacity is not sufficient.

In most quarter-hours, the costs for the use of balancing energy exceed the revenues. Nevertheless, a negative financial balance is possible in a few quarters of an hour.

Depending on the current demand of the control zones in the GCC, positive or negative secondary control energy is used by the grid control, independent of the quarter-hourly time frame. The GCC balance position is positive if the GCC control areas have a deficit on average within the quarter of an hour. It takes a negative value if they have a surplus. Therefore, the IP can take on both positive and negative values.

The +/- sign of the IP has a direct effect on the payment direction within the balancing group (BG) settlement. The following four constellations are possible in principle:

1. Positive IP and short BG balance: BRP pays to TSO
2. Positive IP and long BG balance: TSO pays to BRP
3. Negative IP and short BG balance: TSO pays to BRP
4. Negative IP and long BG balance: BRP pays to TSO

The IP of a quarter of an hour applies to all balancing groups, regardless of whether they are short or long.

For the calculation of the uniform imbalance price (reBAP), further framework conditions have to be taken into account, which are considered in the following chapters. For a better understanding, the description is divided into several calculation steps, in each of which IP intermediate results are determined. These are numbered consecutively and ultimately lead to the actual uniform imbalance price (reBAP). The quotient defined above is therefore given the designation $\boldsymbol{IP_1}$.

2 Price cap (IP2)

In the case of a small GCC balance in the denominator of the formula, high balancing energy prices can arise if imbalances with changing signs occur within the quarter of an hour, which largely cancel each other out over the quarter of an hour in the GCC balance. In order to avoid extreme imbalance prices with consequent extreme cash flows between individual or many BRP's, the IP is limited to the largest absolute value of all balancing energy prices of the activated individual contracts for aFRR and mFRR $\left| EP_{max} \right|$, an $\boldsymbol{IP_2}$ is determined:

$$IP_2 = \begin{cases} (-1) * min\{|IP_1|, |EP_{max}|\} & IP_1 < 0 \\ min\{|IP_1|, |EP_{max}|\} & IP_1 \geq 0 \end{cases}$$

Please note:

- How to deal with the resulting deficits is described under point 7.

3 Additional price cap (IP20)

As part of the coordination of an industry solution between the TSOs and the BRP's, an $\boldsymbol{IP_{20}}$ was drawn up at industry association level as an additional capping step and approved for implementation by the Federal Network Agency. The objective of the further limitation is to avoid high imbalance prices for GCC balances between -125 MWh (-500 MW) and +125 MWh (+500 MW) remaining after calculation step IP_2.

The limitation is carried out with a linear increasing/decreasing function depending on the GCC balance. To determine the limiting function, the volume-weighted average price of the 1-h product of the regarding hour from EPEX Spot's intraday trading (P_{ID}) is subject to a surcharge/discount of between 100 and 250 €/MWh. An $\boldsymbol{IP_{20}}$ is determined for this purpose:

$$IP_{20} = \begin{cases} \begin{matrix} if\ IP_2 < 0\ and\ -125 \leq Balance_{GCC} \leq 125, \\ (-1) * \min\left\{|IP_2|, \left| P_{ID} - \frac{100€}{MWh} - \frac{150€}{MWh} * \left| \frac{Balance_{GCC}}{125\ MWh} \right| \right| \right\} \end{matrix} \\ \begin{matrix} if\ IP_2 \geq 0\ and\ -125 \leq Balance_{GCC} \leq 125, \\ \min\left\{|IP_2|, \left| P_{ID} + \frac{100€}{MWh} + \frac{150€}{MWh} * \left| \frac{Balance_{GCC}}{125\ MWh} \right| \right| \right\} \end{matrix} \\ \begin{matrix} else, \\ IP_2 \end{matrix} \end{cases}$$

Please note:

- How to deal with the resulting deficits is described under point 7.

4 Price comparison with the German Intraday Spot Market (Incentivising component, IP3)

For the calculation of $\boldsymbol{IP_3}$, the IP_{20} is compared with the Intraday Price Index (ID AEP) described below. Furthermore, a minimum distance is established between the ID AEP and $\boldsymbol{IP_3}$.

For the calculation of ID AEP, all trades of the quarter-hourly product and the hourly product of continuous electricity trading on the intraday market in the market area Germany of the relevant electricity exchanges[1] are taken into account. The index of the respective settlement period includes the trades of the corresponding quarter-hourly product whose trading time has the shortest time interval from the beginning of the settlement period and whose total trading volume (V_{ID}) exactly reaches or exceeds 500 MW.

Only if the trading transactions of the quarter-hourly product do not reach a volume of 500 MW in a settlement period, the trading transactions of the hourly product which covers the settlement period and whose trading time has the shortest time interval from the beginning of the settlement period shall be supplemented to the extent that the total trading volume of the hourly products and quarter-hourly products exactly reaches or exceeds 500 MW. The volume-weighted average price is formed from the trading transactions determined in this way.

[1]Nominated Electricity Market Operator (NEMO) operating continuous intraday trading in the German Market Area are currently EPEX Spot SE and European Market Coupling Operator AS (NordPool AS)

The index is not defined in a settlement period if the total volume of 500 MW is not reached. In these time periods, no imbalance price coupling takes place.

Between the ID AEP and **IP₃**, a minimum distance of 25%, but at least 10 €/MWh is established, provided that the absolute value of the GCC balance is greater than or equal to 500 MW. For a GCC net balance of 0 MW, no distance is set. In the range between 0 and 500 MW it increases linearly with the amount of the GCC balance. The minimum distance (ΔP) is thus determined as follows:

$$\Delta P = \max\left\{10\frac{€}{MWh} * \frac{\min\{125\ MWh, |Balance_{GCC}|\}}{125\ MWh}, IDAEP * \frac{\min\{125\ MWh, |Balance_{GCC}|\} * 0{,}25}{125\ MWh}\right\}$$

The IP_3 is then calculated as follows:

$$IP_3 = \begin{cases} \max\{IP_{20}, ID\ AEP + \Delta P\} & Balance_{GCC} > 0\ and\ V_{ID} \geq 500\ MW \\ \min\{IP_{20}, ID\ AEP - \Delta P\} & Balance_{GCC} < 0\ and\ V_{ID} \geq 500\ MW \\ IP_{20} & else \end{cases}$$

Please note:

- The IP_3 can change its sign compared to the IP_{20}.
- The handling of the resulting surpluses is described under point 7.

5 Surcharge/discount on the IP (Scarcity component, IP4)

In quarter hours in which the balance of the GCC has a value of at least 80% of the dimensioned FRR for the GCC in the corresponding direction, the scarcity component is applied. In the case of a positive balance of the GCC (undersupply), the scarcity component forms the lower limit for the reBAP for the respective quarter hour. In the case of a negative balance of the GCC (oversupply), the scarcity component forms the upper limit for the reBAP for the respective quarter hour.

The scarcity component is a second order function (parabolic curve) as a function of the balance of the GCC. The function term is calculated as follows:

$$IP_4 = \begin{cases} max\{IP_{Inc},\ f_{scar,pos}\} & Balance_{GCC} \geq P_{db,pos} \\ min\{IP_{Inc},\ f_{scar,neg}\} & Balance_{GCC} \leq P_{db,neg} \\ IP_3 & else \end{cases}$$

whereas

$$f_{scar,pos} = IP_{Inc} + \left(2 * BP_{cap} - IP_{Inc}\right) * \left(\frac{Balance_{GCC} - P_{db,pos}}{P_{RES,pos} - P_{db,pos}}\right)^2,$$

$$f_{scar,neg} = IP_{Inc} + \left(-2 * BP_{cap} - IP_{Inc}\right) * \left(\frac{Balance_{GCC} - P_{db,neg}}{P_{RES,neg} - P_{db,neg}}\right)^2,$$

$$P_{db,pos} = 0.8 * \sum\left(P_{aFRR,pos} + P_{mFRR,pos}\right),$$

$$P_{RES,pos} = \sum(P_{aFRR,pos} + P_{mFRR,pos} + P_{disload} + P_{capres}),$$
$$P_{db,neg} = -0.8 * \sum(P_{aFRR,neg} + P_{mFRR,neg}),$$
$$P_{RES,neg} = -\sum(P_{aFRR,neg} + P_{mFRR,neg} + P_{disload} + P_{capres}).$$

Whereas

BP_{cap}	Highest permissible bid price in intraday exchange trading
IP_{Inc}	Intraday Price Index including minimum distance: $ID\ AEP + \Delta P$ respectively $ID\ AEP - \Delta P$
$Balance_{GCC}$	Balance of the German Control Cooperation
$P_{db,pos}$	Dead band in case of shortfall. This corresponds to 80 % of the dimensioned positive aFRR
$P_{db,neg}$	Dead band in case of surplus. This corresponds to 80 % of the dimensioned negative aFRR
$P_{Res,pos}$	Sum of the dimensioned positive FRR plus the contracted disconnectable loads and the contracted capacity reserve
$P_{Res,neg}$	Negated sum of the dimensioned negative FRR plus the negated sum of the contracted disconnectable loads and the negated sum of the contracted capacity reserve.
$P_{aFRR,pos}$	Power of the dimensioned positive aFRR
$P_{aFRR,neg}$	Power of the dimensioned negative aFRR
$P_{mFRR,pos}$	Power of the dimensioned positive mFRR
$P_{mFRR,neg}$	Power of the dimensioned negative mFRR

Please note:

- In quarter hours in which the balance of the GCC has a value of less than 80 % of dimensioned FRR for the German control block in the corresponding direction, the scarcity component has no effect.
- The IP_4 can change its sign compared to the IP_3.
- The handling of the resulting surpluses is described under point 7.

The function f_{scar} results from rounding to two decimal places in €/MWh. If the IP_4 is not used, there is no rounding.

6 Capacity Reserve Regulation

The requirements of Section 32 of the Capacity Reserve Regulation are taken into account in addition to the steps described above for determining the reBAP. This means that, in the application case according to Section 32 (2), a reBAP that deviates from the steps described above is billed for the BRPs short positions.

7 Offsetting of deficits and surpluses

The price adjustment from IP_1 to IP_4 results in differences between the costs for the balancing energy delivery and the revenues of the balancing groups settlements.

The price adjustment in step IP_2 creates financial deficits for the TSOs. The price adjustment in steps IP_3 and IP_4 creates financial surpluses for the TSOs, which are offset against the financial deficits from step IP_2per calendar year.

The resulting net amount from steps IP_2, IP_3 and IP_4 is taken into account when determining the grid usage fees.

The industry solution described under point 3 with the establishment of the calculation step IP_{20} leads to deficits and surpluses (in the calculation step IP_{20} itself as well as in the subsequent calculation step of the market price coupling IP_3) - these are netted over all ¼-h of the month and offset in the reBAP of the corresponding month. The settlement is carried out via an additional price component, which, depending on the sign of the GCC balance, represents a price premium or discount (price premium in the case of a positive GCC balance, price discount in the case of a negative GCC balance) that remains constant over the month in every ¼-h on the IP_4.

Please note:

- The calculation of the increase/decrease in revenue of steps IP_2, IP_3 and IP_4 is carried out as if capping step IP_{20} did not exist. This ensures that the relevant requirements for inclusion in the grid usage fees from stipulation BK6-12-024 are not affected by the industry solution.

8 Dealing with price corrections after publication of the reBAP

The price corrections resulting from the correction of errors (additional or reduced revenues) are offset in the reBAP of the following month. Clearing is carried out via an additional price component, which, depending on the sign of the GCC balance, represents a price premium or discount (price premium for a positive GCC balance, price discount for a negative GCC balance) in ¼-h that remains constant over the month.

The TSOs will limit the amounts to be rolled over in any one month to a maximum of 3% of the regular balancing energy costs incurred in that month. In addition, the surcharge or discount on the reBAP is limited to 3 €/MWh in order to ensure that the influence on the reBAP is appropriate even in ¼-h with relatively low reBAP.