REPORT

System-supporting balancing group management

Co-regulation by market players stabilizing the electricity system

This is a machine translated version of a study originally published in German. The original is available at neon.energy/systemstützende-bilanzkreisbewirtschaftung

Final version from November 12, 2023

On behalf of Axpo Deutschland GmbH, BayWa r.e. AG, CF Flex Power GmbH, Danske Commodities A/S, Optimax Energy GmbH, Statkraft Markets GmbH, Sunnic Lighthouse GmbH and Wind Energy Trading WET AG

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All analyses and interpretations in this study are based on public data and market knowledge. We have no information about the behavior of individual FCAs, past or present. In particular, we have no insight into trading books or strategies. The views and opinions expressed are those of the authors only and do not necessarily reflect those of the clients of this study.

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Summary

There has long been a debate in the German energy industry as to whether balancing group managers should only minimize their own balance deviations or also take the system state into account. In system-supporting balancing group management, individual balancing groups tend to take a position opposite to the system balance, thereby contributing to its stabilization and supporting the balancing energy system. The financial incentive for this lies in the balancing energy price, which is designed in such a way that system-supporting behavior is rewarded and system-stressing behavior is penalized.

This has three main advantages over balancing energy:

- Thanks to lower market access barriers, more installations and players can participate in system support.
- New information such as updated weather forecasts can be continuously taken into account in system operation, while balancing energy only allows short lead times.
- As not all balancing groups are capable of optimal management, some market parties can specialize in system forecasts. The balancing groups that serve the system are in fierce competition with each other in terms of innovation, which leads to a constant improvement in forecasts.

The practice of system-supporting balancing group management is likely to have contributed significantly to the fact that, despite the five-fold increase in wind and solar capacity over the past 15 years, the need for balancing power in Germany has halved in the same period.

We are not convinced by the frequently cited arguments against system-supporting balancing group management. Some seem to be based on misunderstandings about market mechanisms, such as concerns about oscillations between quarter hours. Other problems can be addressed, such as possible credit risks from depositing collateral. Another group of arguments are more substantial, but affect balancing energy in the same way, such as the need for a robust and redundant IT infrastructure.

We therefore recommend the following:

- The existing legal situation in Germany should be clarified and system-supporting balancing group management should be explicitly permitted at least until intraday gate closure.
- Better data availability is recommended, especially the publication of the German system balance in near real time.
- The publication of system balance-relevant data should be viewed with the same level of reliability and IT security as the standard service.
- Financial security for payment obligations via collateral to be deposited seems sensible.

The possibilities and limits of system-supporting balancing group management within the current quarter hour should be investigated further.

Table of Contents

1 Introduction

System stability. Frequency stability and a balanced system balance are prerequisites for the operation of electricity grids. The transmission system operators are legally responsible for ensuring this, contracting balancing power for this purpose and, if necessary, procuring it via the balancing energy market and calling it up when required.

System-supporting balancing group management. At the same time, however, the practice of system-supporting balancing group (BG) management has existed for many years in Germany and other European countries, in which individual balancing groups tend to take a position opposite to the system balance so that they also contribute to balancing the system balance. This is sometimes also referred to as "co-regulation by market players". In concrete balancing practice, this means that balancing group managers make marketing decisions under uncertainty (especially wind and solar generation), taking into account the expected system usefulness and their own risk position. This is in contrast to marketing that focuses solely on the volume deviation of its own balancing group and is blind to the state of the system. The financial incentive for system-supporting balancing group management lies in the difference between the balancing energy price and the price on the wholesale market and a reduced risk of large balancing energy payments.

Effects. System-oriented balancing group management enables systems outside of balancing power to contribute to a stable system balance. As our and previous analyses show, it generally stabilizes the system, except in periods in which the balancing energy price formula was designed in such a way that no robust, system-supporting price signal was sent. Thanks to a better system balance, less balancing energy needs to be activated. The lower expenditure and costs for balancing energy reduce balancing energy prices, which in particular relieves the financial burden on balancing groups of renewable energies and smaller market players, which tend to have larger relative forecast errors for structural reasons. The need to provide balancing power also tends to fall, which has a positive effect on grid fees, benefiting all electricity consumers. A more balanced system balance also increases operational system security, as the amount of available balancing capacity is limited.

Legal situation. From a legal perspective, the current situation of system-supporting balancing group management in Germany is quite paradoxical: on the one hand, there are financial incentives for system-supporting balancing group management, but on the other hand, the balancing group contracts prohibit these incentives from being followed. Based on discussions with TSOs and regulatory authorities, our knowledge of the market, the reporting on system imbalances in June 2019 and the discussion on the mixed price method as well as our own empirical studies (Hirth & Ziegenhagen 2015, Koch & Hirth 2019, Neon 2021), our understanding is that in practice, system-supporting balancing group management is tolerated to a certain extent by some TSOs and occasionally even welcomed, as it is system-supporting in the vast majority of cases. This is also reflected in the publication of the "grid traffic light", with which the TSOs publish the system balance in stages: After all, such publication only makes sense at all if it is to be noticed by BRPs and used for portfolio management. However, market players are exposed to legal risks and, in the final instance, risk their balancing group contract and thus their existence as an electricity market player through system-supporting balancing group management. As part of a current amendment to the Energy Industry Act, there are now plans to legally prohibit system-supporting balancing, which is currently only regulated in the balancing group contract. The explanatory memorandum to the draft bill stated: "In particular, it is not permissible to strive for or accept an imbalance in the balancing group with reference to the grid control network balance or the balancing energy price." This justification can no longer be found in the current EnWG draft.

This study. Against this background, we summarize the current situation, the arguments for and against system-supporting balancing group management and a series of existing and new quantitative analyses in this short study. We also discuss the legal situation in some European countries. On the basis of the knowledge gained, we consider system-supporting balancing group management through balancing groups to be an important element of a competitive electricity market based on renewable energies and argue for a liberalization of the regulatory requirements. On the other hand, a tightening would have considerable financial costs and risks for operational system management.

2 Current status

2.1 Principle of system-supporting balancing group management

Principle. The principle of system-supporting balancing group management is simple: balancing responsible parties (BRP) prepare a forecast of the imbalance price (German "Ausgleichsenergiepreis", AEP) and then target a deviation from the schedule. The balancing group is therefore deliberately over- or under-balanced (long or short position in relation to the balancing energy). They profit from the difference between the balancing energy price and the current intraday price at the time of the decision, the so-called imbalance price spread. With this behavior, BRPs generally stabilize the system balance and thus support the work of the TSOs, namely whenever the individual positioning reduces the system balance. This is generally the case if the incentives are designed correctly, which has almost always been ensured since the last reform of the AEP price form. In addition to the price itself, the availability of data also plays a relevant role: the more real-time information about the state of the system is known to the market, the more likely it is that balancing group management will be beneficial to the system.

Balancing group management as a market. With system-supporting balancing group management, the logic of the electricity market is extended to real time, so to speak. In this light, this is the logical continuation of the idea of a competitive, free electricity market. The AEP plays the role of a price signal to which market players and TSOs trade energy up to real time. As in other markets, the idea here is that market players are subject to price incentives and then make decentralized decisions, resulting in efficient deployment and investment decisions. While balancing energy is based on centrally controlled power plant deployment, active balancing group management is based on decentralized dispatch decisions. The AEP propagates backwards into the various wholesale markets via the expectations of the market players. It is therefore ultimately the expectation of the AEP that provides the financial incentive for trading on the day-ahead or intraday market in the first place.

RE marketing context. In practice, active balancing group management must often be understood in connection with the risk-minimizing marketing of wind and solar energy. Active management then results from the fact that direct marketers choose a risk-averse marketing strategy in view of the fact that generation forecasts are always subject to uncertainty. This is done as follows: At any given time, marketers do not have a single point forecast of their generation, but several forecast intervals or percentiles from different forecast providers. Their dispersion reflects the forecast uncertainty. It then makes economic sense to take the asymmetric financial and systemic risks into account when making marketing decisions. If, for example, positive balancing energy is significantly more expensive than negative balancing energy, a system shortfall would lead to higher costs than a surplus. In such a situation, it is rational for direct marketers to act conservatively within the forecast uncertainty, i.e. to market at the lower end of the forecast interval, so that the probability of a shortfall is lower than that of an excess. From a system perspective, this is economically efficient and conserves the valuable resource of balancing capacity; from a BRP perspective, it is risk-averse hedging against asymmetric risks in the balancing energy price.

Terminology. There is no standardized terminology for system-oriented balancing group management; in fact, very different terms are used in the scientific literature and the European energy policy debate, reflecting the different perspectives. In Germany, grid operators often speak of "co-regulation (‘Mitregeln’) by balancing group managers", while market players use terms such as "system-supporting balancing" or "active balancing group management". In English, the terms "passive balancing", "decentral balancing" or "implicit balancing" are used or the term "position taking" is used. While the terms describe the same phenomenon, they have very different connotations:

- The "deliberate positioning" emphasizes the difference between the resulting balancing group deviations and a purely random, unintentional deviation.
- While the term "co-regulation" evokes associations with the high-frequency activation of aFRR, "system-supporting balancing group management" emphasizes quarter-hourly balancing. We prefer to use this term in this study.
- The term "passive balancing" describes the behavior from the perspective of the TSOs, which, in contrast to balancing energy, do not actively call up quantities. In contrast, BRPs are quite active in passive balancing - from a trader's perspective, they deliberately take open positions in relation to balancing energy.
- The term "implicit balancing" is also aimed at the contrast to balancing energy, because volumes are not explicitly called up, but a reaction to price signals takes place.
- "Decentral balancing" emphasizes that forecasting and deployment decisions are made decentrally by various market players, while balancing energy is controlled centrally by grid operators.

Scope. A precise quantification of system-supporting balancing group management requires, on the one hand, data from all balancing groups that are not public. On the other hand, a distinction would have to be made between intentional and unintentional balancing group deviations, which would not be easily possible even if the data were available. In contrast, the reaction to balancing energy prices became visible in situations in which the economic incentives exceptionally favored system-damaging behavior, such as in June 2019. In section 5 we discuss which statements are possible on the basis of public data.

2.2 Varieties of the practise

Varieties. System-supporting balancing group management can be differentiated according to whether it is carried out through active activity or by allowing imbalances to occur, whether it is carried out on the basis of 15-minute settlement periods or within these periods, and whether it is implemented through own investments or through trading transactions.

Active / passive. Conceptually, two types of system-supporting balancing group management can be distinguished: On the one hand, active position taking, e.g. through a trading decision on the intraday market, or on the other hand, passive (but deliberate) acceptance of a schedule deviation that occurs by chance. However, from a system perspective and also financially, both lead to the same result and are therefore to be regarded as equivalent. This also means that system-supporting balancing group management cannot necessarily be reconstructed in retrospect by evaluating trading books or plant deployment decisions.

Predictive / real time. In addition, a distinction can be made between forward-looking, system-supporting balancing group management within the 15-minute settlement periods and co-regulation within the current balancing period. The latter is only possible with our own highly flexible systems. The prerequisite for forward-looking system-supporting balancing group management is always a foreseeable imbalance in the system balance. Such forecasting can only be successful if other market players - possibly some RE marketers or differential balancing groups of distribution system operators - do not operate optimal portfolio management. This is the case, for example, if suboptimal forecasting methods are used, not all existing data is used, balancing is only carried out on an hourly basis or plant outages are not immediately taken into account. Forward-looking, system-supporting balancing group management is therefore the other side of the coin to suboptimal balancing group management.

Physical. Finally, a distinction can be made as to whether the system-supporting balancing group management is carried out by own flexible plants ("physical") or by trading transactions ("financial"). In the case of physical management (Figure 1), a BRP uses its own plants, for example power plants, batteries or (the curtailment of) wind or solar plants. This can be done either in advance or within the current quarter of an hour.

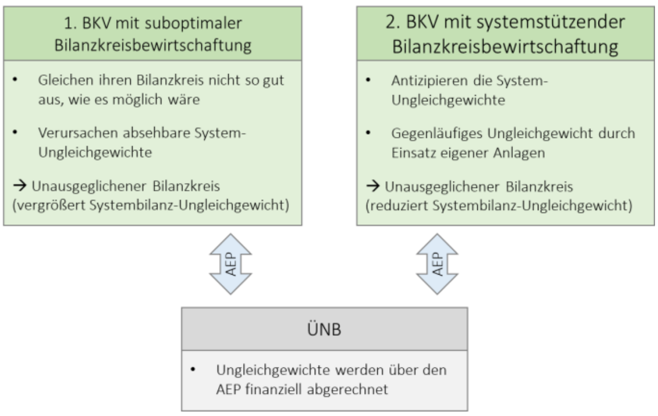

Figure 1. Actors involved in "physical" system-supporting balancing group management.

Financial. In the financial variant (Figure 2), which we believe to be more significant in terms of volume in Germany, involves two other BRPs in addition to the BRP with suboptimal balancing group management: A trading company ("forecasting BRP") anticipates that the system balance will be unbalanced. However, it does not react with its own plants, but trades on the intraday market. On the opposite side of the trading business are "flexibility balancing groups", which ultimately physically reduce the imbalances with their own plants without themselves having an imbalanced balancing group. This financial variant is always forward-looking and cannot react to signals from the current balancing period because the market is already closed at this point.

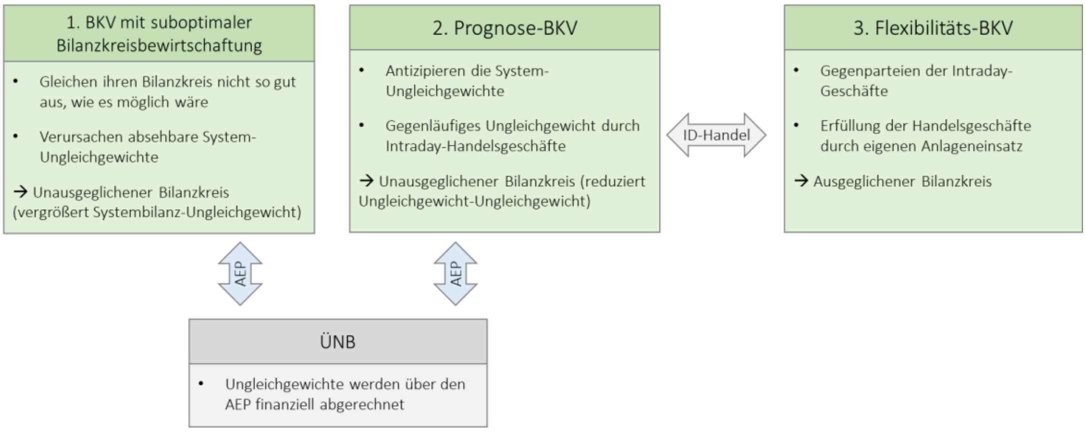

Figure 2. Actors involved in "financial" system-supporting balancing group management.

2.3 Legal situation

Balancing group contract. Currently, the practice of system-supporting balancing group management violates Article 5 of the balancing group contract approved by the Federal Network Agency (Bundesnetzagentur, 2020a). This is also referred to as "the obligation to physically balance the balancing group":

> Art. 5.1 "The BRP shall be responsible for a balanced quarter-hourly power balance of the feed-ins and withdrawals allocated to its balancing group, for proper schedule management and for the economic settlement of any remaining balance deviations."
>
> Art. 5.2 "The balancing group manager is obliged to take reasonable measures, in particular by taking appropriate care when preparing the forecasts, to keep the balance deviations as low as possible. The use of balancing energy to cover the load or to compensate for an oversupply of the balancing group is only permitted insofar as this compensates for deviations that cannot be forecast."

In response to the events in June, the obligation to physically balance the balancing group was reaffirmed by the Bundenetzagentur (2020b).

EU law. The EU Balancing Guideline (Regulation 2017/2195) and the Internal Electricity Market Regulation (Regulation 2019/943), on the other hand, explicitly mention the possibility of BRPs contributing to system stabilization as an option on an equal footing with the obligation to maintain balancing group loyalty:

> Balancing Guideline Art. 17(1). "Each balancing group manager shall endeavor in real time to balance its own balancing group or to support the electricity supply system."
>
> Internal Electricity Market Regulation Art. 5(1). "Each balancing group manager shall be financially responsible for its balancing group deviations and shall endeavor to balance its own balancing group or contribute to balancing the electricity system."

Current legal situation. A recent legal article by Wessling (2021) argues that system-supporting balancing group management is covered by these EU regulations and that both the balancing group contract and the position paper of the Federal Network Agency are therefore obsolete. It would therefore be permitted today by directly applicable European law. To our knowledge, this issue has not yet been clarified in court.

Data availability. At present, system-supporting balancing group management in Germany is also made more difficult by the fact that data on the system status is published late or inaccurately. For example, the system balance is published at the earliest a few minutes after the end of the delivery period and the final AEP only several weeks later. The so-called grid traffic light, which appears with a deliberate time delay and aggregation to five minutes, only indicates the sign and order of magnitude of the system balance. Instead, BRPs that also market balancing capacity use balancing capacity calls in practice as indicators for the system balance, as our statistical analysis of intraday price jumps suggests (Neon 2021).

3 Advantages of system-supporting balancing group management

There are two mechanisms by which a deviation in the system balance is prevented and reduced in Europe: The activation of balancing energy by TSOs and the active balancing group management of market parties subject to the incentive of the balancing energy price. In this section, we discuss the advantages of the latter for the operation of the electricity system, also in comparison to balancing energy.

3.1 Advantages for the system

Advantages. System-supporting balancing group management generally ensures a more balanced system balance, i.e. smaller net deviations in the sum of all balancing groups. As a result, fewer calls for balancing energy are required, which tends to reduce the balancing energy price. This is particularly important for marketers of renewable energies, distribution system operators and small players such as municipal utilities, for whom balance deviations are often more significant. A reduced need for balancing power can also be expected, which will lead to lower costs and therefore reduced grid fees for all electricity consumers. A more balanced system balance should also contribute to operational system security, simply because the volumes to be balanced at short notice are smaller. This can be particularly helpful in extreme situations when the available balancing capacity reaches its limit or is insufficient, because all physically available plants can contribute to system stabilization, regardless of whether they are contracted as balancing capacity or not.

Comparison with balancing energy. The alternative to system-supporting balancing group management is the greater use of balancing energy. This raises the question of what advantages it offers and whether an equally stable system balance can be achieved efficiently using balancing energy alone. While balancing energy has its own advantages - in particular the rapid regulation of aFRR and the provision of capacity with very high availability - system-supporting balancing group management also offers its own advantages: Thanks to lower barriers to entry, more players and plants can contribute and reactions to emerging imbalances can take place earlier and therefore with more lead time. In addition to these fundamental advantages of the electricity market, system-supporting balancing allows market participants to specialize so that economies of scale can be exploited in forecasting (

Figure 3). These mechanisms are explained below.

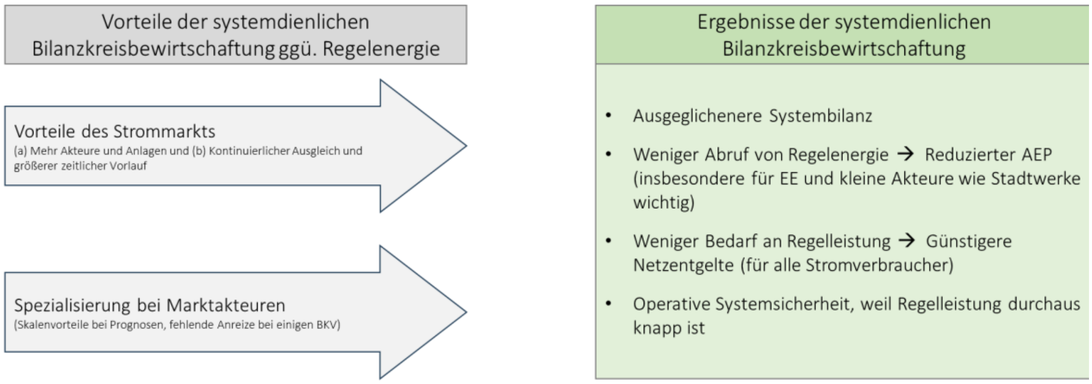

Figure 3. Advantages of system-supporting balancing group management.

3.2 Advantages of the electricity market compared to balancing energy

The electricity market has two advantages over balancing energy: It has lower barriers to entry and has a longer lead time.

3.2.1 More players and systems

More plants. With system-supporting balancing group management, the system balance is not only balanced by prequalified providers of balancing energy, but also via the electricity market. This also enables smaller and non-prequalified systems to contribute to system stabilization, as well as those for which a fixed commitment to provide balancing power is not suitable or which shy away from the corresponding effort. This applies, for example, to flexible consumers, electricity storage systems, CHP power plants and renewable energies. The prequalification of small systems in particular tends to involve a great deal of effort.

Balancing energy. The balancing power market has high market access barriers. This applies to prequalification, where increased technical requirements in terms of redundancy, IT security and continuous availability as well as safety requirements are applied as critical infrastructure. Each technical system must be prequalified separately and this process must be repeated every five years. Although there may be the potential for simplifications for individual requirements (such as a type prequalification for small systems), the requirements are basically reasonable and are based on the high availability expectation of the control power, so that these access barriers cannot simply be removed.

RE. It is also difficult for direct marketers of renewable energies to settle balancing energy with the system operators. There is still no prequalification methodology at all for solar energy. As a result, only a fraction of the 150 GW of installed wind and solar capacity is currently active on the balancing energy market.

Reforms. Reforms to the procurement of balancing energy, which are welcome in themselves, have unfortunately further increased the administrative burden of participating in these markets in recent years. This includes, for example, the switch to 15-minute time slices or the introduction of the balancing energy market.

Electricity market. The electricity market, with its significantly lower barriers to entry, is obviously more attractive to a large number of systems and players than the balancing power procurement auction. This can be seen, for example, in the fact that transmission system operators are increasingly concerned about being able to cover the demand for balancing power at all and, in particular, very high balancing energy prices are being called for, although the demand for balancing energy has fallen sharply in recent years. At the same time, the intraday market has seen a sharp rise in trading volumes and order book depths over the years. The trading volume on the day-ahead market is already orders of magnitude higher than the demand for balancing energy.

Cross-border. In addition, within the framework of cross-border intraday trading, all plants in other European countries are in principle also available as a resource, while the cross-border balancing energy platforms MARI and PICASSO in turn only enable plants participating in balancing energy abroad to be called up.

Assessment. Thanks to significantly lower barriers to entry, the electricity market is therefore the more inclusive mechanism that enables more players and systems to contribute to system stabilization than balancing energy can. The greater choice of providers makes the system more economically efficient and reduces the costs of balancing the system. A kind of division of labor seems to make sense, in which balancing energy with its higher requirements offers a faster and more reliable system of regulation, and the electricity market with system-supporting balancing group management offers a more comprehensive system with broader participation. It is the combination of balancing energy and active balancing group management that offers the highest level of system security and the lowest costs.

3.2.2 Continuous equalization and greater lead time

Predictability. Some causes of system imbalances are stochastic, i.e. they occur unexpectedly and cannot be predicted in individual cases. These include, for example, short-term outages of power plants and interconnectors. Due to their short-term nature, such deviations must be compensated for by plants that can be activated quickly. However, not all system imbalances are so unpredictable. Some deviations can be anticipated because they follow fixed calendar patterns. These include, for example, the differences between continuous physical load ramps and discrete hourly products or bridge days, on which inadequate management of DSO balancing groups regularly leads to foreseeable imbalances.

System balancing. In principle, such deviations can also be compensated for cheaply by systems with longer start-up times and do not require the speed of balancing power. Using the permanently available, quickly retrievable and therefore expensive balancing power to compensate for foreseeable imbalances is a waste of this valuable resource, as the available power lies idle for most of the time. System-supporting balancing group management can compensate for such deterministic system imbalances cost-effectively by utilizing the available lead time. Expensive balancing energy is replaced by cheaper procurement on the upstream wholesale markets.

RE forecast errors. Between these two extremes are the forecast errors for wind and solar generation, which neither occur at very short notice nor can they be predicted well in advance. These generation forecasts are created and updated continuously. In the hours before delivery, the market thus receives a steady stream of information regarding the expected feed-in. This information is worthless for balancing energy, which is called up at the earliest a few minutes before delivery. The situation is different with system-supporting balancing group management: as soon as new information is available on the market, e.g. because a trader uses new and better forecasts, these are translated by trading companies into day-ahead and later into intraday bids and can thus be immediately converted into physical reactions by generation plants and storage facilities. This hinge function, which continuously translates generation forecasts first into price signals and then into physical generation, is an elementary task of the intraday market. Figure 4 illustrates a typical period on the intraday market in which the prices of products with successive delivery periods continuously react to new information.

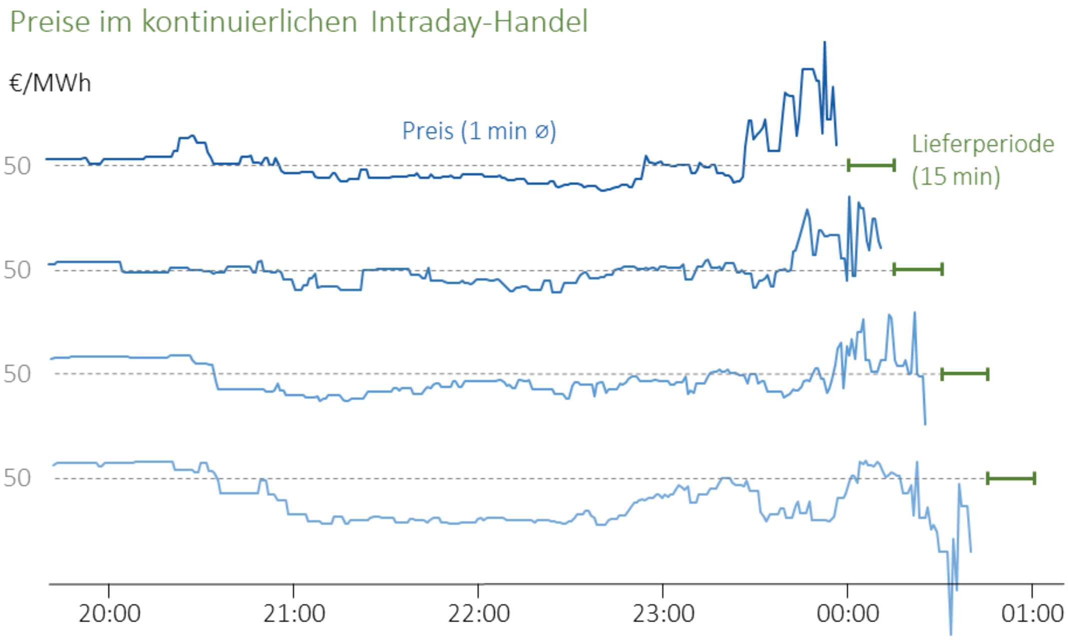

Figure 4 Volume-weighted 1-minute average of prices in continuous intraday trading for the quarter-hourly products traded in parallel with delivery between 00:00 and 01:00. In the minutes in which no trading transactions took place for a product, the price from the previous minute continues to apply.

3.3 Specialization among market players

Imperfect forecasts. Around 10,000 balancing groups are registered in Germany. If every single one of them were to create the best available forecasts based on all available data and then manage the balancing group with 24/7 intraday trading on a quarter-hourly basis, there would be no role for system-supporting balancing group management: because every single balancing group would already be optimally managed, there would be no predictable imbalances in the system balance.

Inefficiency. However, such perfect management by each individual balancing group manager would be highly inefficient because data collection, forecasting and trading are themselves resource intensive. This trade-off is already evident today in the balancing group contract, which does not require the best possible balancing, but merely "reasonable measures".

Specialization. System-supporting balancing group management allows market parties to specialize to a certain extent, as not every DSO can or wants to manage its balancing group perfectly and not every direct marketer forecasts generation in the best possible way. This task is taken over by other specialized balancing group managers as part of system-supporting balancing group management. This happens without the need for a contractual relationship beyond balancing energy. In effect, a "forecasting balancing group manager" then takes over the forecasting tasks of "balancing group managers with suboptimal balancing group management". This specialization makes economic sense and is to be welcomed for four reasons: Firstly, analysis activities such as forecasting are subject to significant economies of scale, so it would be inefficient if thousands of balancing groups did this independently. Secondly, not all balancing group managers are subject to efficient incentives, for example state-owned and regulated companies. Thirdly, the transaction costs between forecasting service providers and the large number of balancing groups would be very high.

Forecasting competition. The fourth and probably most important reason is that the forecasting of system imbalances is an area that is constantly and rapidly evolving. New weather models, new statistical methods, machine learning and artificial intelligence, as well as new data sources and measurement methods, are enabling ever more precise forecasts. These improvements do not come about by themselves but are driven by intense competition for innovation: balancing groups that operate system-supporting balancing group management are in competition with each other. The competition for better forecasts, data and methods promotes innovation and leads to a general improvement in forecast quality in the long term.

4 Classification of the arguments against system-supporting balancing group management

In this section, we discuss arguments against system-supporting balancing group management that are repeatedly raised in the debate. Some of these concerns appear to be based on misunderstandings about market mechanisms, such as concerns about quarter-hour oscillations. Other problems can be easily addressed, such as credit risks due to the depositing of collateral. Another group of arguments are more substantial but relate to balancing energy as well as system-supporting balancing group management, such as the need for a robust and redundant IT infrastructure. Overall, we do not consider any of the counterarguments known to us to be convincing or weighty enough to outweigh the advantages.

4.1 Limits of system-supporting balancing group management

Comparison of balancing energy. System-supporting balancing group management does not replace the system of balancing energy. On the one hand, a balanced system balance can only be achieved on a quarter-hourly average; on the other hand, the provision of balancing power means a higher degree of reliability. However, system balancing can reduce the use of balancing energy and also contribute to a reduction in the provision of balancing capacity.

4.2 False incentive through the balancing energy price

Problem. In exceptional situations in the past, the balancing energy price has provided a false incentive, i.e. an increase in the system imbalance gives the BRPs a financial advantage. This was the case on a large scale in June 2019, for example. As a result, there were major imbalances in the system balance of up to 10 GW on several days.

Price formula. The risk of a false incentive depends primarily on the price formula of the balancing energy price and the determination of the price factors contained therein. The false incentives in 2019 were caused by the introduction of an unsuitable award criterion for the procurement of balancing capacity, the so-called “Mischpreisverfahren“ (mixed price procedure), in conjunction with an AEP price formula that was essentially based on the (greatly reduced) balancing energy prices. In response to the dramatic events, not only was the mixed price procedure abolished again, but above all the balancing energy price formula was reformed.

Exchange price coupling. On the one hand, the exchange price coupling was revised by setting a minimum price based on a new intraday price index. Whereas previously the volume-weighted average of all trading transactions with the respective hourly product was used, since then the last 500 MW traded of the respective quarter-hourly product have been taken into account (ID500 price index). If the trading volume of the quarter-hourly product is less than 500 MW, trading transactions of the hourly product are also taken into account. If less than 500 MW is traded for both product types, there is no exchange price coupling. Furthermore, an additional minimum distance between the AEP and the price index has been introduced. This means that system-damaging trading transactions shortly before delivery lead by definition to a financial disadvantage for the BRP. This means that, especially shortly before the end of the trading period, BRPs always have an incentive to trade in a way that is beneficial to the system.

Scarcity component. The so-called scarcity component was also introduced. This causes the AEP to rise sharply if more than 80% of the control reserve has to be activated. This is particularly the case with high system imbalances, as shown in an example from September 12, 2023 at 7:30 am: Here, the system imbalance was at -3206 MW (shortfall), meaning that the scarcity component pushed the AEP to -6686 €/MWh.

Single price procedure. Independently of this, in connection with the introduction of MARI and PICASSO, pricing at the balancing energy auctions was harmonized across Europe and converted to a single price procedure (*marginal pricing*). All activated bidders in the balancing energy auction now receive the same price for balancing energy, which is derived from the highest activated bid. As a result, the AEP increases more quickly when larger quantities of balancing energy are called up with the same bids than was the case with the previously used pay-as-bid procedure. However, if MARI and PICASSO meet expectations and allow more favorable suppliers to be called up, this in turn tends to have a price-reducing effect.

Assessment. Overall, we consider the current system for determining the balancing energy price to be extremely robust. It is possible that there is a misguided incentive for individual trading transactions with small volumes. However, this cannot lead to market transactions on a large scale, because otherwise the correct price coupling would take effect again. We therefore no longer consider the occurrence of false incentives to be problematic.

4.3 Oscillations between quarter hours

Concern. In the public debate, the concern is repeatedly expressed that system-supporting balancing group management could cause the system balance to "swing" or "overshoot". As we understand it, the concern about oscillations is based on the fear that balancing group managers use the current or past AEP or the system balance as a predictor for the upcoming AEP. If a sufficient number of market players did this, the following scenario would be conceivable: The system is under-covered in a period. As soon as market players observe this, they take a long position, i.e. they overcover. Because many FTPs are individually over-covered, this leads to the system being over-covered. The same BRPs then go short again, causing a shortfall in the system.

Assessment. Such a self-reinforcing or self-perpetuating oscillation of the system balance is only possible if market players make their forecasts of the future system balance solely on the basis of the past system balance, ignoring the fact that other players also react accordingly, i.e. they do not validate their models. Such systematically incorrect forecasts would very quickly imply high payment obligations for the relevant market players, as they would be systematically penalized financially by the balancing energy price. We consider it impossible that market players would rely on such a primitive forecasting model and would not correct it within a very short time if they realized that it inadequately predicts the future system balance. On the contrary, there is even a financial incentive to counteract these oscillations. So if the system were to actually start oscillating, traders would immediately be found who would make themselves financially better off by dampening it. We therefore see no reason why such oscillations should occur between quarters.

Real-time information as an antidote. Strictly speaking, the described oscillations should only occur when market participants use historical system balances as a predictor for the future system balance - i.e. in the current system. The publication of real-time system balance data would make this mechanism obsolete. As no oscillations can be observed today, we consider these concerns about oscillations to be unfounded. They may be based on misunderstandings about how trading decisions are made in practice.

4.4 Misleading information

It is repeatedly argued that missing or misleading information on the system status could lead to a greater system imbalance with system-supporting balancing group management.

4.4.1 Incorrect information on the current system status

Problem. BRPs can only manage their balancing groups in a way that serves the system if they know the current system status. There is therefore no reaction or it may even go in the wrong direction if the relevant information is not published or is published incorrectly due to technical problems.

Valuation. Of course, it can be assumed that incorrect system information leads to incorrect behavior on the part of market players from a system perspective. However, this argument applies to every control loop, including the activation of balancing energy. If the data basis required for this is incorrect, the wrong balancing power would also be called up. In order to reduce the risk of incorrect/missing information, the same requirements for robustness, redundancy and security of the information technology must therefore be applied as are used for the current balancing power controller, for example. In the event of incorrect data, publication could be temporarily halted.

4.4.2 Complexity due to European balancing energy

Problem. aFRR and mFRR reserves have been called up across borders via the PICASSO and MARI platforms for some time. Since then, the activation of balancing power has been more strongly influenced by events abroad and it has become more difficult to estimate the state of the German system balance on the basis of activations (because the activation can also be made for abroad).

Assessment. This argument is an argument against the use of balancing power calls as an indicator for the system balance, but not the system-supporting balancing group management itself. If real-time information on the system balance is published, it does not pose a problem for the system balance. In addition, for reasons of free competition, it is not desirable to have to draw conclusions about the state of the system from the activation of balancing capacity, which is not known to everyone (which does happen in practice, see Neon 2021).

4.5 Credit risks of the TSOs vis-à-vis BRPs

Problem. As with all trading transactions, system-supporting balancing group management also creates financial obligations between the contracting parties, in this case the BRP and the TSO. As with all contracts, this creates an incentive for financially risky trading activities with the deliberate acceptance of insolvency risks ("moral hazard"): Companies could take high risks, quickly distribute profits to owners and file for insolvency in the event of major losses in order to avoid having to bear them.

Valuation. As in any other market, such as the electricity exchange, collateral should be required for positions taken. It would make sense for schedule deviations by the BRP to be permitted only up to an amount that is covered by the collateral deposited. Higher deviations would simply be penalized financially. Similar mechanisms are used successfully in other markets, so we see no problem here. Apart from that, such fraudulent behavior is of course also possible in the event of a ban on systemic accounting, because it is based precisely on the fact that an actor exploits the system once and then evades responsibility through insolvency.

4.6 Interaction with grid bottlenecks

4.6.1 Use of balancing energy for congestion management

Problem. Balancing energy is called up at the same price throughout Germany. In the event of grid congestion, grid operators can deviate from this principle through so-called out-of-merit order calls and thus relieve the grid. In practice, the separation of balancing energy and congestion management is therefore less clear than in theory. In decentralized balancing group management, on the other hand, the TSOs have no influence on the location of the system.

Assessment. The use of balancing energy to relieve the grid violates the principle that balancing energy extends across bidding zones. Moreover, this is not possible with pool bids. Congestion should be eliminated by expanding the grid or managed as part of congestion management. If this is not possible, the bidding zone would have to be split in accordance with current European law. Irrespective of this, the significance of out-of-merit order calls has fallen sharply since 2016/17 (Figure 5).

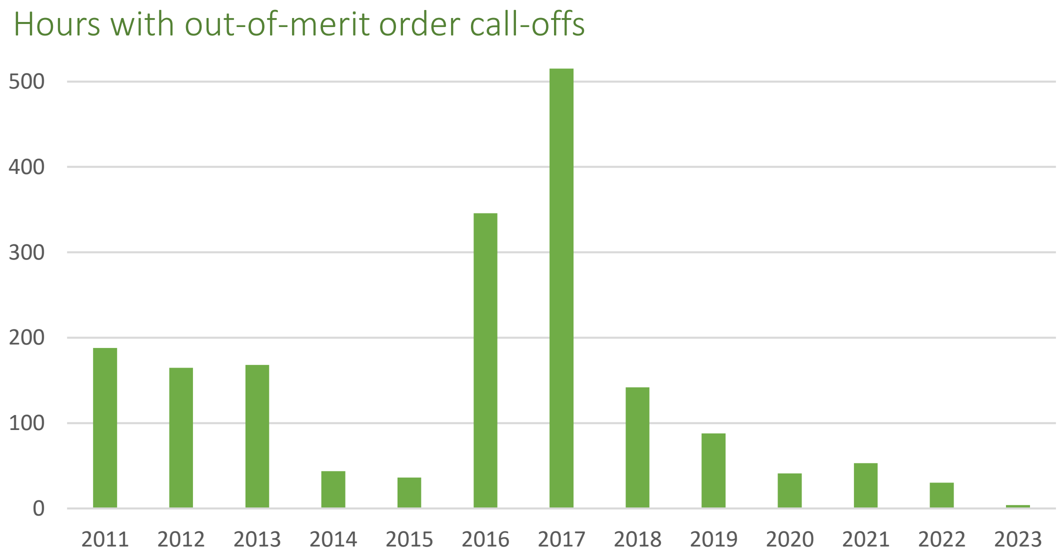

Figure 5 Out-of-merit orders for secondary control power since 2011. Own illustration based on 50Hertz Transmission GmbH et al. (2023b)

4.6.2 Use of underground timetables

Argument. It is sometimes argued that the schedules reported during the day would lose their usefulness for the operational processes of the grid operators in the case of system-supporting balancing group management because the reported and actually planned production volumes would no longer match.

Valuation. For the load flow calculations in preparation for redispatch, schedules have no value anyway because they are reported on a balancing group basis and not on a system basis. They are less useful for forecasting the system balance and balancing energy requirements precisely because (and only because) the system balance deviations are reduced. In our view, this is not an argument against balancing group management that supports the system, but for it.

4.7 Undesirable behavior within the quarter of an hour

Beyond the above arguments, which can be refuted or resolved, more substantial problems can arise that are attributable to quarter-hourly balancing.

4.7.1 Overshooting within a quarter of an hour

Problem. Because the balancing energy and the balancing energy price are averaged over 15 minutes, the balancing group managers have an incentive to focus on the *average* imbalance in each quarter of an hour - and not on the current system balance, which would be desirable in principle. An example will illustrate this: If the system balance was strongly negative at the beginning of a quarter hour, the AEP for the quarter hour in question will be determined by the costs for the initial positive balancing power activation, so that there is an incentive to over-cover until the end of the quarter hour, even if the system has since over-covered again, i.e. a change in the sign of the system balance has taken place. This creates an incentive to turn the system balance within the quarter of an hour instead of returning it to zero. As we understand it, this possible phenomenon is sometimes referred to as "swinging" or "over-shooting".

Assessment. This undesirable incentive only affects operators of highly flexible plants that can react to extremely short-term signals within a quarter of an hour. It is therefore a problem of physical co-regulation, but not of financial balancing group management that is beneficial to the system. In addition, this behavior is also associated with a financial risk for the balancing group manager. Above all, however, this problem also exists in the current system of physical balancing: a balancing group manager that was under-covered for the first 7.5 minutes of a quarter of an hour is in principle obliged to be over-covered for the next 7.5 minutes in order to have a balanced schedule on average.

4.7.2 Provoking imbalance peaks

Problem. Theoretically, it is possible to influence the AEP in a desired direction with very short imbalance peaks. In this case, a balancing group manager would increase the balancing energy price by deliberately causing a very short imbalance (e.g. one minute) in order to profit from it for the remaining time (i.e. 14 minutes). It tends to be easier to provoke high imbalances when the system is already unbalanced. With a convex structure of the energy charge merit order, it is possible that the additional costs incurred by the BRP for the initially provoked high control reserve activation are lower than the revenues generated in the following period. This behavior also takes advantage of the discrete duration of the balancing period and would be mitigated by shortening it.

Assessment. Deliberately provoking an imbalance peak is destabilizing, jeopardizes operational system security and is economically inefficient. This also requires the operation of highly flexible systems, such as a battery. In addition, the energy charge merit order must be strongly convex so that the AEP is disproportionately increased by a short-term strong imbalance, but only decreases slightly in the area of smaller imbalances. This price effect must also be foreseeable by the balancing group manager, i.e. it must know that a strong charging of the battery will provoke a very high-priced balancing energy activation. The cross-border activation of balancing energy by MARI and PICASSO therefore complicates this strategy, as it makes the working group merit order more difficult to forecast. In addition, the activation of mFRR takes place with an activation time of 5 minutes, so that an instantaneous increase in the balancing energy activation, as assumed in the example above, is not possible in reality. The longer the reserves take to react to the imbalance, the lower the induced price effect. Such a strategy may also be a violation of REMIT or other regulations to prevent abusive behavior. Nevertheless, consideration could be given to issuing specific rules for behavior within balancing periods for highly flexible installations. This should be done independently of the system-serving balancing group management.

4.7.3 Provoking a balancing energy activation

Problem. If a BRP is also a provider of balancing power, it can try to provoke the activation of its own balancing power through appropriate behavior and thus profit financially. In this case, the profit comes from the balancing energy, not from the balancing energy. This strategy is already possible today; in fact, there was a prominent case in October 2017 in which a balancing power provider submitted a balancing energy bid of €77,777/MWh, which was incredibly high by the standards of the time, and was actually called up. (As a result of this incident, the mixed price procedure was introduced for the awarding of balancing energy bids, with the well-known consequences described in section 4.2 described in section 4.2).

Assessment. Deliberately provoking a balancing power call is destabilizing, jeopardizes operational system security and is economically inefficient. It also has nothing to do with system-supporting balancing, because the profits come precisely from balancing energy and not balancing energy. Such a strategy may also be a violation of REMIT or other regulations to prevent abusive behavior.

5 Quantitative analyses

The arguments against system-supporting BG management discussed in the previous section express the fear that the system balance can also get out of hand if market players also react to market incentives instead of striving exclusively for balanced balancing groups. This section discusses the extent to which these fears are justified based on the development of the system balance and the incentives on the intraday market over the course of history.

5.1 The German rule paradox

The control paradox. The empirical observation that the installed generation capacity of wind and solar energy has risen sharply while the required control power has fallen sharply over the same period has become known as the "German control paradox", as shown in Figure 6 illustrated. This is at odds with energy industry intuition and modeling studies, which actually suggest an inverse relationship if the absolute errors in generation forecasts and thus the need for balancing power increase as the output of weather-dependent generators rises. In the 15 years from 2008 to 2023, the increase in wind and solar capacity in Germany amounted to 408 %. At the same time, the amount of tendered positive and negative balancing capacity (aFRR + mFRR) *fell* by 50 %. Figure 6 shows the ex-ante perspective of the TSOs, which dimension the amount of balancing capacity put out to tender on the basis of the maximum expected system imbalances.

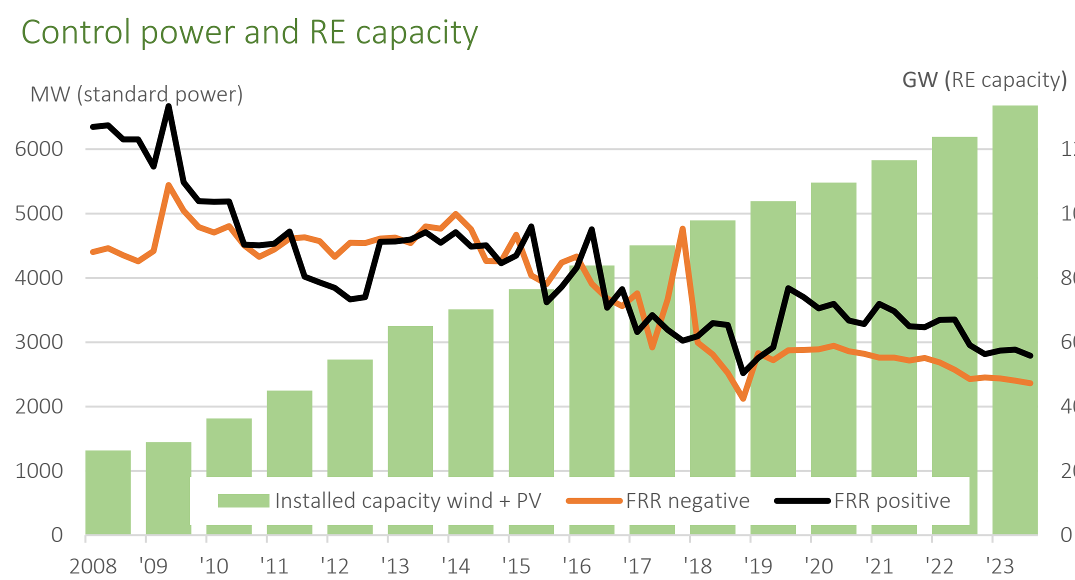

Figure 6 Tendered balancing capacity and installed wind and PV capacity in the period 01.01.2008 - 30.06.2023. The balancing capacity shows the sum of tendered aFRR and mFRR capacity per quarter. The installed wind and PV capacity refers to the beginning of the year. Own illustration based on 50Hertz Transmission GmbH et al. (2018, 2023a) and Arbeitsgruppe Erneuerbare Energien Statistik (2023).

Explanatory approaches. We described the German control paradox in Hirth & Ziegenhagen (2015). Possible explanations include improved wind and solar generation forecasts, increased TSO cooperation and more active management of balancing groups on the intraday market. In fact, the avoidance of opposing balancing power calls due to the introduction of the intra-German grid control network from 2010 and the International Grid Control Cooperation from 2011 provides a plausible explanation for the decline in the need for balancing power up to 2011 (Ocker & Ehrhart, 2017). In addition, the introduction and increased trading of quarter-hourly products on the intraday market from December 2011 also reduced the system balance deviations and thus the need for balancing power (Koch & Hirth, 2019). More active balancing group management on the intraday market therefore plays a decisive role in stabilizing the system balance. As we explained in section **Fehler! Verweisquelle konnte nicht gefunden werden.** it is likely that some market players ("forecasting balancing groups") will play this role more actively than others and compensate for the balancing group deviations of suboptimally managed balancing groups through system-supporting balancing group management.

Long-term stability. How Figure 6 shows, the decline in balancing power demand has continued even after the introduction of the grid control network and quarter-hourly trading. This is also underlined ex-post by the development of system balance deviations over time. As Figure 7 shows, these initially decreased with the introduction of the grid control network in May 2010 until the beginning of 2015. In the winter of 2011/2012, they increased again significantly, which can be explained by power plant outages, but also by the start of direct marketing of EEG plants from January 2012 and an unusually cold February 2012 (Bundesnetzagentur 2012). They then stabilized around 350 MW from 2015 onwards. Even greater deviations are usually below 1 GW in 95% of cases. One exception is the period from October 2018 to July 2019, in which the system balance averaged 470 MW again. This period falls within the time of the mixed price procedure, in which there were significantly reduced standard energy prices (see section 4.2).

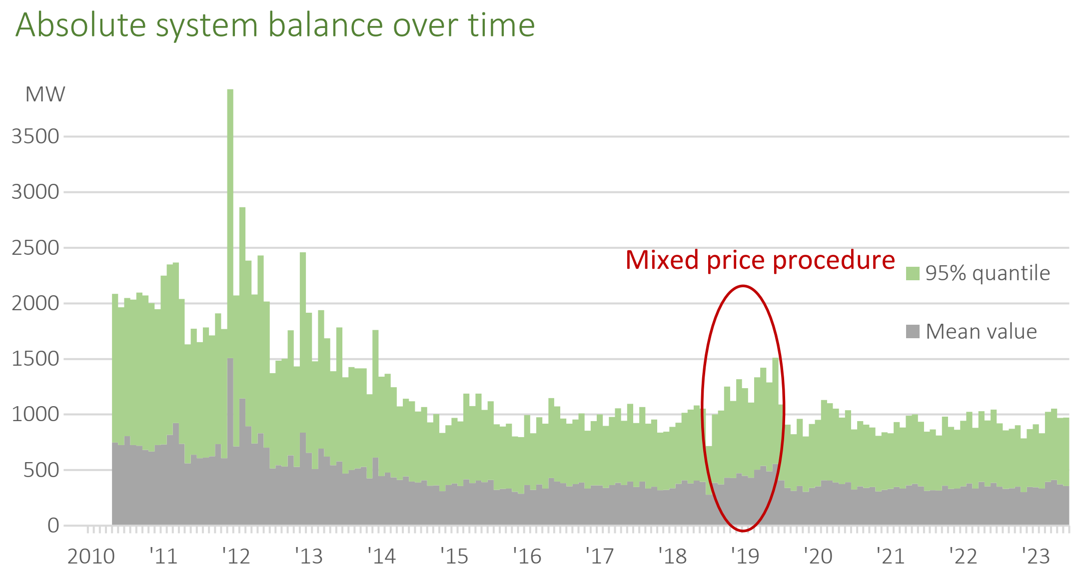

Figure 7 System balance deviations in the period May 2010 to June 2023. Monthly mean value (gray) and 95% quantile (green) of the absolute deviation. Own illustration based on 50Hertz Transmission GmbH et al. (2023c).

Stable system balance despite strong RE expansion The development of the system balance and wind and PV capacity shows that the overall system balance has not deteriorated over time despite challenging conditions and has even improved over long stretches, as long as this was supported by the incentives on the intraday market. At least part of this development can probably also be attributed to system-supporting balancing group management. The following section discusses these incentives in detail.

5.2 The essential role of the right incentives

Incentives and imbalances. The decisive incentive to enter into a system-supporting position on the intraday market results from the imbalance price spread, i.e. the difference between the AEP and the intraday price. If the AEP is above the intraday price (positive imbalance price spread), there is an incentive for market participants to take a long position, i.e. to cover their own balancing group; if the sign is reversed, taking a short position is profitable. These incentives support the system if positive imbalance price spreads occur when the system is undercovered (positive NRV balance) and vice versa. Figure 8 shows that this was the case almost consistently in at least 90% of the quarters. During the period of the mixed price procedure in 2018/19, however, the incentives on the intraday market were less system-supporting than before and after. It was precisely during this period that the increase in system imbalances described above was observed. With the abolition of the mixed price procedure, the proportion of quarter-hours with system-supporting incentives rose again, up to 99% in 2023, whereby no additional improvement in the system balance can be observed above 95% system-supporting incentives.

System balance and intraday incentives

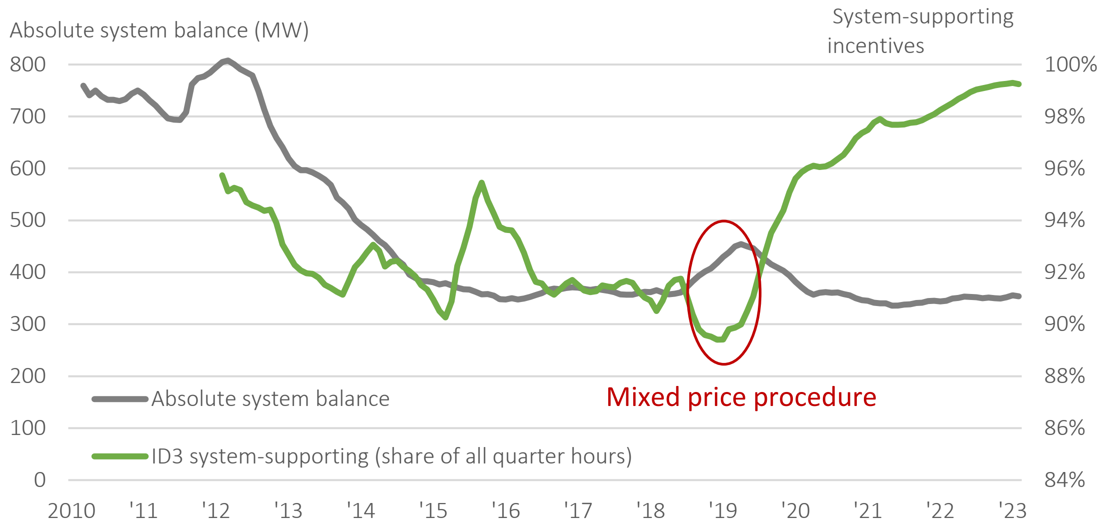

Figure 8 Annual rolling average of the absolute system balance deviation and the proportion of quarter hours in which market players on the intraday market were exposed to system-supporting incentives. The intraday price was based on the volume-weighted average price of trading transactions 3 hours to 0.5 hours before delivery (ID3). Quarter hours with AEP > ID3, NRV balance positive and AEP<ID3, NRV balance negative are counted as system-supporting. The publication of the ID3 by EPEX begins in June 2015. Earlier observations were supplemented by own calculations based on tick data. Own presentation based on 50Hertz Transmission GmbH et al. (2023c, 2023d) and EPEX SPOT SE (2023).

Overall, there is also a system-supporting correlation between intraday incentives and system balance: the more frequently the imbalance price spread supported system-supporting behavior within a month, the lower the system balance (Figure 9).

Intraday price incentives and system balance

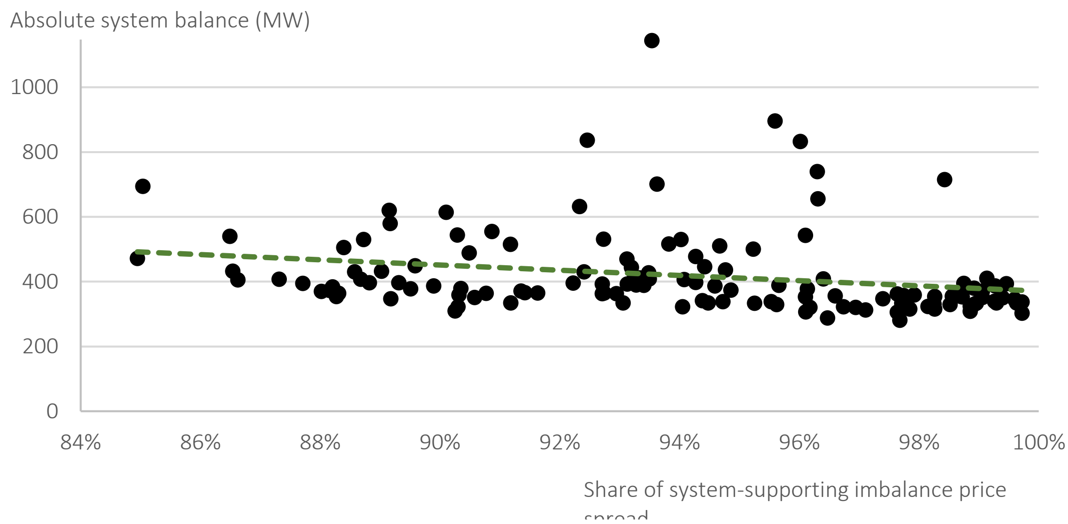

Figure 9 Correlation between the mean value of the absolute system balance and the respective proportion of quarter hours in which market players on the intraday market were exposed to system-supporting incentives. Each point represents one month of the observation period. For each percentage point of system-supporting incentives, the system balance deviation was on average 8 MW lower. Own illustration based on 50Hertz Transmission GmbH et al. (2023c, 2023d) and EPEX SPOT SE (2023).

Attractiveness. The extent to which system-supporting balancing group management is economically attractive is determined by the absolute imbalance price spread per quarter hour. This is shown in Figure 10 is shown. Here, too, it can be seen that system-supporting behavior was rewarded to a lesser extent during the mixed price procedure than at other times.

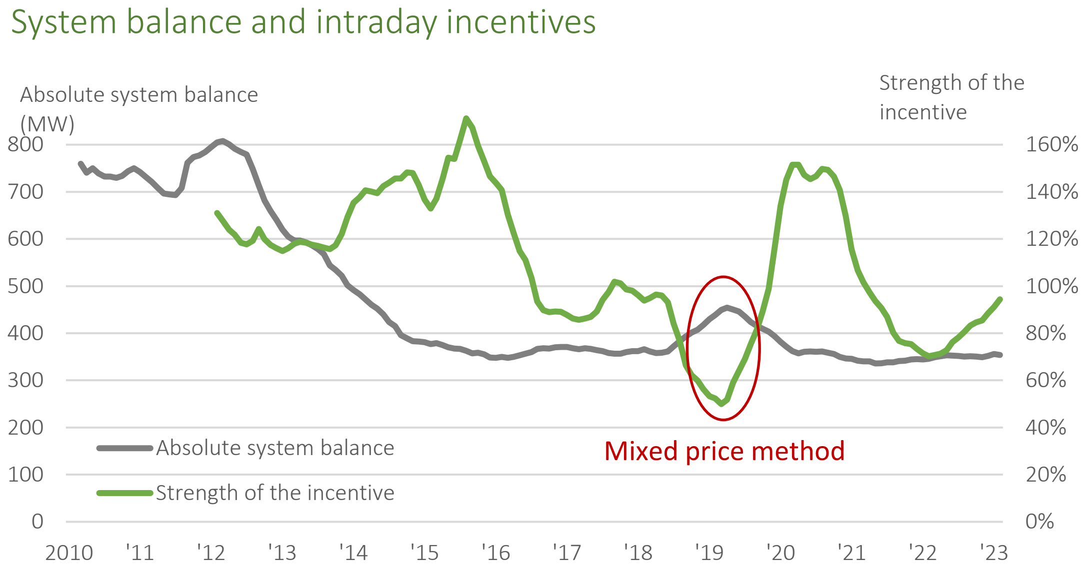

Figure 10 Annual rolling average of the absolute system balance deviation and the absolute imbalance price spread. The strength of the incentive is determined by the absolute imbalance price spread between AEP and ID3. In order to ensure comparability over time, especially during the 2022 energy crisis, the imbalance price spread was standardized with the average day-ahead price of the month (monthly base). An incentive strength of 100% therefore means that the imbalance price spread was just as high as the monthly base, which was on average €35/MWh in the years before the energy crisis, but up to €465/MWh during the energy crisis in 2022. Own illustration based on 50Hertz Transmission GmbH et al. (2023c, 2023d) and EPEX SPOT SE (2023).

Summary. Overall, it can be said that the system balance has remained remarkably stable since 2015, despite the ongoing expansion of wind and solar energy. In our opinion, this success is also due to the system-supporting balancing group management. Major system imbalances only occurred when the incentive regime on the intraday market was poorly calibrated and have not occurred since the abolition of the mixed price procedure.

5.3 Effect of system-supporting balancing group management in Germany

Quantification. It is obvious that system-supporting FC management reduces the average system balance within a trading period and thus relieves the electricity system. However, quantifying this effect is not trivial.

Challenge. The methodological challenge in quantifying causal relationships lies in the large number of interactions between the balancing energy price, intraday price and system balance. For example, a deviation between the intraday price and the expected AEP encourages an open position, which influences the system balance. Conversely, an increased system balance leads to a higher AEP because more expensive balancing energy has to be activated. Such an interaction between mutually influencing variables is referred to in statistics as endogeneity. It means that a simple regression from the AEP to the system balance incorrectly estimates the causal relationship between the two variables. The regression cannot distinguish between the many, sometimes opposing, effects.

Methodology. In a research article, we used a different method based on publicly available data to quantify the relationships in the German balancing energy system (Eicke, et al., 2021). We interpreted the balancing energy system as a market: the intersection of supply and demand in each quarter of an hour indicates the resulting balance between the balancing energy price and the system balance (Figure 11). The supply function for balancing energy describes how much the AEP rises when the system balance increases and therefore more expensive balancing energy power plants have to be activated. The demand function for balancing energy, on the other hand, shows how much the BRPs in Germany change their (open) positions when the balancing energy price rises. If all BRPs were to carry out their balancing group management independently of the AEP, the AEP would have no influence on the system balance.

Instrumental variables. To estimate the two functions, we used instrumental variables, a

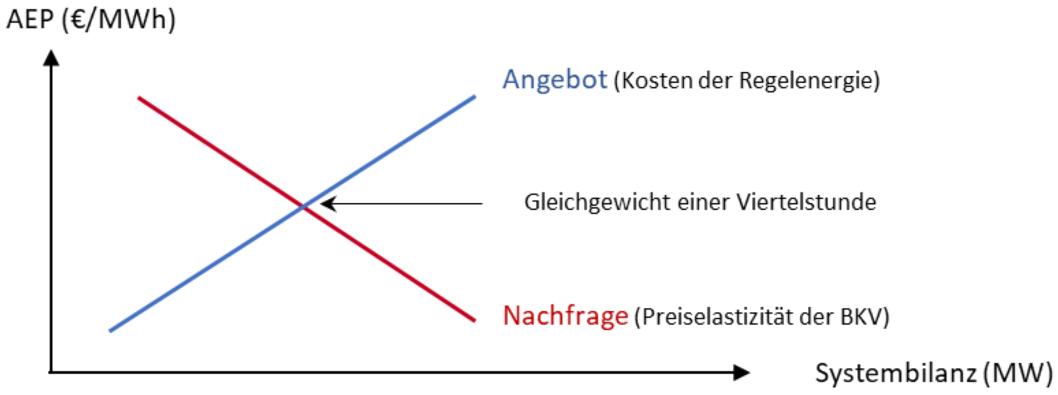

Figure 11Interpretation of the balancing energy system as a market equilibrium

proven methodological approach for endogeneity. We illustrate the two-step procedure using the demand function as an example. In the first step, a hypothetical AEP is estimated using a variable (the "instrument") that has a significant effect on the AEP but is not itself influenced by the system balance. We have used the average cost of a balancing energy activation. These differ over time, as different amounts of balancing energy are available at different times. At the same time, these bids themselves are independent of the actual system balance. In the second step, the isolated effect of the AEP on the system balance can be estimated by analyzing how the system balance behaves in relation to the AEP estimated on the basis of the balancing energy costs.

Effects. This approach makes it possible to quantify the effect of exogenous shocks on the AEP or the system balance. It shows that an increase in the balancing energy price by 1 €/MWh leads to a decrease in the system balance by 2 MW, all other things being equal. We can also estimate that a forecast error of 100 MW (i.e. a shift in the supply function), e.g. due to an earlier than expected wind front, only leads to a change in the system balance of 90 MW.

Classification. Our results suggest that system-supporting FC management is already common practice today, at least for individual FCMs. The fall in the system balance as the price rises also proves that the system is actually relieved if the economic incentives are set correctly, as has been the case since the extensive revision of the AEP formula in recent years. This avoids the activation of balancing energy, which reduces grid costs and leads to lower average AEPs. RE system operators and utilities in particular, where schedule deviations can never be completely avoided, benefit from the resulting reduction in balancing energy costs.

Benefits to date. The approach helps to quantitatively understand the effects of system-supporting FC management. However, it is not possible to determine how high the average system balance would have been without system-supporting FC management, as this would result in a completely new equilibrium. What is certain, however, is that the system balance would increase on average. An effective ban on system-supporting FC management would therefore not only fail to exploit the efficiency potential that would be possible through system-supporting FC management, but the effects of lower system balances that have already been achieved would also be lost.

6 Comparison with other European countries

European perspective. In many European countries, system-supporting FC management is seen as helpful. This is illustrated, for example, by the position of the Belgian transmission system operator Elia, which sees system-supporting FC management as an equally important pillar for maintaining the system frequency, together with the balancing energy system:

> "*To maintain or restore the balance in the system, Elia relies on two pillars. The first pillar consists in providing market parties with the correct incentives to maintain the balance in their own portfolios and/or to deviate from a balanced portfolio in order to support balancing the system. The second pillar consists of so-called balancing reserves that are contracted by Elia to resolve residual imbalances. These balancing reserves consists of a variety of assets that can increase/decrease their injections/offtakes from the grid upon request of Elia to restore the balance in the system*." (Elia, 2023)

Legal classification. In many European countries, BRPs are allowed to occupy both balancing and grid-supporting positions, for example in the Netherlands, Belgium, the United Kingdom, France, Austria and Denmark (Table 1). We are not aware of any country in which a statutory or contractual regulation explicitly excludes system-supporting balancing group management, as the German balancing group contract does.

Additional framework conditions. In addition to the question of whether this behavior is legal, there are other aspects that favor system-supporting balancing group management. These include the prompt publication of relevant data as well as the calculation methodology of the AEP.

Data availability. Earlier data availability significantly facilitates system-supporting FC management. At the time the position is taken, the AEP and the average system balance in the relevant quarter of an hour are not yet known. They must therefore be estimated by the BRPs. The more up-to-date the data available, the more accurate this estimate will be. Publishing the current system balance or the activation of balancing energy and the AEP as soon as possible therefore makes it easier and more attractive for BRPs to take an open position. This increases the positive effects of system-supporting balancing group management. In addition, better data availability reduces erroneous system-damaging behavior due to incorrect forecasts. The fact that many countries publish the system balance or the activation of balancing reserves very promptly underlines the fact that system-supporting balancing group management is actively supported there (Table 1). In the UK, the activation of balancing energy is published in real time. The system balance in Belgium and the Netherlands can be accessed on the TSO website within two minutes. In Germany, the direction of the system balance is at least announced by the grid traffic light, but with a time delay. One consequence of a lack of data availability is that market players draw conclusions about the system balance from the activation of control power. However, this practice is only possible for those companies that also offer balancing energy (Neon, 2021). This gives large players a systematic advantage.

Calculation of the AEP. The design of the AEP also has a major influence on whether system-supporting balancing group management is economically attractive. In the past, the level of the AEP in many countries depended on whether the deviation of the individual balancing group supported or burdened the overall system (asymmetric AEP). As a rule, this meant that system-supporting BRPs received compensation for their schedule deviations that was below the AEP, e.g. in the amount of the day-ahead electricity price. This means that system-supporting balancing group management is less or not at all economical. In recent years, however, most European countries have switched to a symmetrical AEP, most recently the Scandinavian countries in 2022. Of the countries examined, only in France does the AEP for an over-covered balancing group differ from that for an under-covered balancing group, which weakens the incentives for system-supporting balancing group management. A hybrid form between symmetrical and asymmetrical AEP is implemented in the Netherlands. The normally symmetrical AEP becomes asymmetrical in hours in which there is no clear trend in the system balance and does not incentivize open positions.

Table 1Legal situation of system-supporting balancing group management and data availability

	System-supporting positions permitted	Symmetrical AEP	Publication of system balance [1]	Publication of AEP forecast
Belgium	Yes	Yes	1 min	2 min
Netherlands	Yes	Mostly	1 min	2 min
United Kingdom	Yes	Yes	Real time	Up to 30 min
France	Yes	No	Up to 20 min	Up to 20 min
Austria	Yes	Yes	Up to 15 min	Up to 45 min
Denmark	Yes	Yes	Approx. 2 h	Approx. 2 h
Germany	No	Yes	Up to 26 min	Up to 45 min

[1] We also take into account publications on balancing energy activation and the IGCC, which allow conclusions to be drawn about the system balance.

7 Recommendations

In our opinion, the opportunities of system-supporting balancing group management outweigh the risks. There are important advantages, also in comparison to balancing energy, and the arguments against system-supporting balancing group management repeatedly mentioned in the discussion can be refuted or addressed. This assessment is supported by the positive experience in Germany and abroad. We therefore recommend the following:

- The existing legal situation in Germany should be clarified and liberalized. Balancing group managers should be explicitly allowed system-supporting balancing group management at least up to intraday gate closure and this should be legally equivalent to physical balancing group management.
- Better data availability is recommended, in particular the publication of the German system balance in near real time. This makes sense in order to strengthen system security, but also to ensure a level playing field for companies.
- The publication of system balance-relevant data should be viewed with the same level of reliability and IT security as the standard service.
- Financial security for payment obligations via collateral to be deposited seems sensible.
- The possibilities and limits of system-supporting balancing group management within the current quarter hour should be investigated further.

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