Strategic deployment of balancing energy in the German electricity market

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1 Introduction

Since the liberalization of electricity markets, integrated markets are transformed into interconnected marketplaces for electricity and the necessary ancillary services. The central marketplace for electricity in an area is the electricity exchange, serving as a price reference for electricity. On these exchanges long-term and short-term futures contracts are traded. Various approaches have been suggested to model prices on the electricity exchanges and manage the associated risk (see for example, Geman and Roncoroni (2006), Trück *et al.* (2007), Römisch and Wegner-Specht (2005), Bessembinder and Lemmon (2002) and de Jong and Huisman (2002)).

An important ancillary services marketplace is the *capacity reserve market*, trading capacity to account for fluctuations and balance the electricity network. It is important to note that this capacity is provided by facilities that could also market their capacity on the electricity exchange. For these facilities the capacity reserve market and the electricity exchange are interchangeable marketplaces. The interdependence of these two markets is analyzed by Weigt and Riedel (2007) and Simoglou and Bakirtzis (2008).

This notion of interchangeable marketplaces is extended to another ancillary service market the *balancing energy market* in Möller *et al.* (2009a). In this paper strategic positions in the German balancing energy market on three different time scales are identified, and linked to corresponding economic incentives. We reverse this point of view and analyze the impact of the identified strategic positions in the day-ahead market. Additionally, we estimate the value of marketing reserve capacity in the balancing energy market.

The paper is organized as follows. Section 2 provides a review of different balancing energy settlement schemes, including a brief description of the German market design. Section 3 summarizes the results of Möller *et al.* (2009a) and Möller *et al.* (2009b). These results constitute the strategic positions that our analysis is based on. In Section 4 we investigate the implications of these positions on the alternative marketplaces, the reserve capacity market and the day-ahead market, respectively. Additionally, we compare these results to relevant studies of market power in Section 5. Section 6 summarizes the results and discusses their implication for the German electricity market.

2 Balancing energy review and German market design

In electricity networks supply and demand have to be in equilibrium at all times, because electricity is practically non-storable. In a given control area the task of monitoring and maintaining this equilibrium is performed by the transmission system operator (TSO). All market participants are organized in balancing responsible parties (BRP). These BRPs provide the TSO with a forecast of their electricity feed-ins and withdrawals. Any deviation from these forecasts will be managed by the TSO and settled with the BRP. The TSO will allocate the necessary capacity prior to the actual balancing in the capacity reserve market and activate this capacity as and when required. In contrast, balancing energy identifies the energy settled with the BRPs causing a disturbance after the actual balancing. In this paper we will keep to a sign convention where positive balancing energy demand indicates a BRP consuming electricity relative to its forecast, and negative balancing energy demand indicates an energy surplus of a BRP relative to its forecast.

In general, BRPs are urged to provide a balanced forecast of their feed-ins and withdrawals of electricity, so the transmission system is close to an equilibrium state. However, BRPs have some flexibility in providing a balanced forecast by concealing part of their forecasted feed-ins and withdrawals. Such forecasting can be viewed as a strategic position in the balancing energy market where the concealed fraction will be settled. Moreover, such a position coincides with a countering position in a futures market where the concealed forecast is withheld from trading. In this sense the balancing energy market is an alternative marketplace to the day-ahead market. We will take up this point in Section 3.

There are two common schemes to settle balancing energy, the single-price settlement scheme and the dual-price settlement scheme. In the single-price scheme the deviation of every BRP to their respective forecast is metered over certain periods. The deviation of every BRP is settled with one common price for each settlement period in the control area. This price is high during periods with a positive net deviation when the control area is in undersupply and low during periods with a negative net deviation. Under the single-price scheme, every BRP with a positive deviation during a settlement period will pay this price for its electricity consumption relative to its forecast. A BRP with a negative deviation will receive this price for its deviation.

Considering the balancing energy price spread between periods of positive and negative net deviation, the single-price settlement scheme provides an economic incentive for BRPs to deviate contrary to the control area's net deviation. Such a position adds up to receiving payments during periods of high prices and making payments during periods of low prices. At the same time, network stability is enhanced by this position as it contributes to balancing the control area's net deviation. Thus, shifting load contrary to the control area's net deviation is similar to the deployment of capacity reserve. In this sense the balancing energy market is an alternative marketplace for capacity reserve.

However, using the balancing energy market as an alternative marketplace to the capacity reserve market and the day-ahead market is controversial. It is argued the implied speculation on the control area's net deviation might endanger network stability by introducing the uncertainty of speculative positions. The dual-price settlement scheme corresponds to this point of view. It sets one price for positive deviations and one price for negative deviations in each period, and can be understood as the single-price settlement scheme with an additional fine for deviating at all.

Nonetheless, the balancing energy market is used as an alternative marketplace for both electrical energy and reserve capacity, even under a dual-price settlement scheme as the examples of Poland and England demonstrate. It is argued in Mielczarski *et al.* (2005) balancing energy is so inexpensive in Poland that market participants supply 4% of their electricity demand via the system's reserve capacity (i.e., 4% of demand is withheld from the futures market). In England on the other hand, balancing energy is said to be so expensive that market participants keep their own capacity reserve (see Kirschen and Garcia (2004)). Thus, the variance reduction of contrary deviations cannot fully unfold, resulting in unnecessary high levels of reserve capacity (i.e., capacity is withheld from the reserve capacity market and the interchangeable futures market).

It is important to note that even though the single-price settlement scheme does not include an explicit fine for deviation, speculators will only benefit from their positions, if they manage to balance the control area's net deviation more often than not. Failing at this will be costly, due to unprofitable prices. Therefore, neither the single-price settlement scheme, nor the dual-price settlement scheme should allow strategic positions to jeopardize transmission system operation. This review of balancing energy suffices in the context of this paper. For a more detailed description and regional specifics of market design we refer to EU (2005) and ETSO (2007).

We conclude this section with the relevant details of the German electricity market. Germany is subdivided into four control areas owned and operated by the four major players in the German electricity market: E.ON AG (e.on), Rheinisch-Westfälisches Elektrizitätswerk AG (RWE), EnBW Energie Baden-Württemberg (EnBW) and Vattenfall AB (Vattenfall). In all four control areas a single-price settlement scheme with quarter-hour settlement periods is implemented.

A common reference for electricity prices in Germany is the European Energy Exchange (EEX). The prominent products at the EEX are day-ahead future contracts for the 24 hour intervals of the following day and corresponding base- and peak-load futures. These futures are used as the underlying in longer-dated futures and often serve as a reference in over the counter (OTC) trades.

The German market design provides economic incentives to use the balancing energy market as an alternative marketplace to the day-ahead market and the capacity reserve market (see Möller *et al.* (2009a)). These incentives lead to a strategic deployment of balancing energy that is especially pronounced because of a large spread between balancing energy prices during periods of positive and negative net deviation. In terms of electricity prices at the EEX this spread is four to five times the price of electricity.

At the same time strategic deployment of balancing energy is limited by grid-access contracts to ensure the stability of the transmission system. As an example, according to a sample contact of the German state agency, the mean deviation should not be "excessively" positive or negative, and deviations should not show "conspicuously" arbitrage-like correlation with day-ahead exchange prices. A BRP not compliant with these limits will be denied compensation during periods of negative deviation, and charged double the day-ahead price additional to balancing settlement price during periods of positive deviation (see

Bundesnetzagentur (2006)).

3 Data basis

There are three strategic positions on different time scales observed in the German balancing energy market. These positions are linked to different economic incentives that are identified and modeled in Möller *et al.* (2009a) and Möller *et al.* (2009b). In this section we briefly present these results that form the basis for our analysis.

As pointed out in Section 2, the smallest delivery period traded at the EEX are hourly day-ahead contracts, while balancing energy is settled in quarter-hourly periods. This discrepancy gives rise to a pronounced pattern, whenever the load profile is not constant within an hour. During a period with an increasing load, the minimal variance forecast that can be balanced with day-ahead market contracts is the average load of that hour. This forecast will lead to a negative balancing energy demand during the first and second quarter-hour and positive balancing energy demand during the third and fourth quarter-hour. Naturally, the same argument with opposite signs holds for a decreasing load. In Möller *et al.* (2009a) this explanation of the quarter-hourly pattern is tested against the empirical pattern and validated.

What is more, Möller *et al.* (2009a) find the shape of the yearly quarter-hourly pattern to remain constant over time, while the amplitude reduces over the years. In fact, the detected pattern of a preceding year describes the quarter-hourly pattern with higher accuracy than the tested model.

Moreover, the reducing amplitude is an indication of market participants adapting their load to obtain less correlation to the quarter-hourly pattern. Such a strategy is neutral with respect to the energy use, but shifts energy demand from periods with higher expected balancing energy demand and prices to periods with lower expected balancing energy demand and prices. We estimate the value of this flexibility in Section 4. In this estimation we apply the detected pattern of the respective preceding year to determine appropriate positions.

After integrating the balancing energy demand to hourly values, the balancing energy demand shows to be directly related to electricity price at the day-ahead market, giving rise to an hourly pattern. In general, this dependence between balancing energy demand and day-ahead market prices can have many reasons. On the one hand, reluctant forecasting and balancing efforts of market participants could lead to an unintentional dependence. On the other hand, the dependence might result from strategic positions trying to exploit the price spread between the day-ahead market and the expected price in the balancing energy market.

The hourly pattern is modeled by Möller *et al.* (2009a) with a factor model and two explanatory factors. These factors separate the hourly pattern into two components. The first component captures the incentive to substitute electricity trades in the day-ahead market with balancing energy, and is implemented as a three parameter factor model. The second component enters technical incentives into the model that are constant over time, and are modeled by the out-of-sample average. The combined model is found to reduce the hourly variance.

In contrast to the quarter-hourly pattern, Möller *et al.* (2009a) find the hourly pattern not to remain constant over time. This behavior is reproduced by the first component of the factor model, and marks the positions to be intentional. Furthermore, Möller *et al.* (2009a) argue only the observed dependence of balancing energy demand and day-ahead market prices let the two marketplaces approach an equilibrium electricity price under the German market design. Thus, the dynamics of the observed positions indicate the hourly pattern to be at least partially attributable to a strategic deployment of balancing energy.

Strategic positions are also present on a longer time horizon. These positions are identified in the residuals of the hourly factor model by a seasonal autoregressive integrated moving average (SARIMA) model. In Möller *et al.* (2009b) this long-term deployment is modeled with a SARIMA-$(1,0,0) \times (1,0,1)_{24}$ model. In this model, a classical tempered stable (CTS) distribution (see, for example Kim *et al.* (2008) and Menn and Rachev (2008)) is chosen for the innovations. This distribution combines two seemingly contradictory properties. On the one hand, the innovations are strongly influenced by extreme events and present heavy-tailed effects. On the other hand, the physical boundary conditions of the energy system impose limits on the range of the innovations. Therefore the CTS-distribution lends itself to risk-management in the balancing energy market.

The SARIMA model is applied for a forecast adapted to two relevant time lags of information disclosure. These two time lags are one month and three days, respectively. Both forecasts revel strategic positions in the balancing energy market that vary over time and are quantified in the yearly mean forecast (see Table 1). This varying offset in the balancing energy demand is attributed to changes in the asymmetry of the balancing energy cost function in Möller *et al.* (2009a).

The hourly pattern and the identified long-term position in the balancing

Table 1: Average prediction of SARIMA model as given in Möller *et al.* (2009b)

	Average prediction					
Horizon	2003	2004	2005	2006	2007	2008
One month	-138.206	-124.043	-75.127	14.461	-81.362	25.492
Three days	-425.342	-292.924	-204.536	15.862	-207.108	17.524

energy market coincide with a countering position in the futures market. Thus, the positions in the balancing energy market depend on the electricity prices in the futures market as captured by the factor model and the cost function respectively. We reverse this dependence and estimate the impact of strategic positions in the balancing energy market on prices in the futures market in Section 4. For this estimation we apply both the factor model of the hourly pattern, and the SARIMA-model of long-term deployment as a basis.

4 Impact on other marketplaces

In Section 3 we discussed the quarter-hourly pattern resulting from the discrepancy of quarter-hourly settled balancing energy and a minimal delivery period of one hour in the day-ahead market. It provides an incentive for BRPs to deviate in opposite direction to the deviation indicated by the quarter-hourly pattern (i.e., receive payments during periods with an expected high net deviation and balancing energy price in the control area, and make payments during periods with low prices).

Let's consider a BRP able to shift part of its portfolio within an hour and obtain a negative correlation to the quarter-hourly pattern for that part. Like the activation of capacity reserve bids, this strategy will reduce the control area's net deviation. By this it aids network security. In this sense, the balancing energy market can be used to market capacity reserve. It is important to note that balancing energy prices are uncertain at the time of portfolio adjustments. Therefore, such strategic positions have no secure profits, but offer statistical-arbitrage gains.

We analyze the profitability of the described strategy in a simulation on historical data. In this simulation we implement a strategy of shifting one MW of electricity within each hour. It is shifted from the two quarter-hour intervals with the highest expected net deviation and prices to the intervals with lower expected net deviation. In this, the expected net deviation is determined by the weekly average pattern of the preceding year (in the case of 2003 we resort to the 2004 pattern). These patterns are calculated as the yearly average values conditional on the hour within a week. Provided the technical feasibility of shifting energy in a portfolio on a 15 to 30 minute timescale, the quarter-hourly pattern can be profitably deployed (see Table 2). However, the profitability differs between the four German control areas. This is a consequence of a differing intensity of the quarter-hourly pattern in the control areas.

Further inspection shows not all hours to contribute equally. Naturally, the arbitrage gains concentrate in the hours with a large gradient of load, when the spread between the expected net deviations within one hour is especially pronounced. As an example, exploiting the arbitrage potential between six and seven at weekday mornings contributes up to 16% to the overall gains, while it only represents 3% of time.

We conclude the quarter-hourly pattern can be used to market capacity reserves. Furthermore, there are two advantages the balancing energy market compared to the capacity reserve market. First, there is no response time requirement to be met. In fact, the described strategy can be implemented already during operational planning procedures. Second, the duration of alternations under the described strategy is at most half an hour. These advantages are par-

Table 2: Estimated yearly gains by shifting 1MW according to quarter-hourly pattern

Year	RWE [€/a]	e.on [€/a]	EnBW [€/a]	Vattenfall [€/a]
2003	38,098	24,815	29,835	47,362
2004	45,503	26,322	33,784	45,234
2005	34,292	24,688	28,800	55,112
2006	37,688	19,521	46,269	65,797
2007	34,517	16,597	40,359	59,183
2008	49,953	13,814	48,932	79,170

ticularly relevant in realizing the demand side management potential of facilities that cannot meet pre-qualification standards of the capacity reserve market. In this context the decreasing amplitude of the quarter-hourly pattern observed in Möller *et al.* (2009a) is an indication of market participants implementing the described strategy.

The quarter-hourly pattern has no interaction with futures markets, as the hourly average value of this pattern is always zero. However, after integrating the balancing energy demand to hourly values, predictable components remain in the data. Whatever the reason behind these positions is, they always coincide with a countering position in the futures market. That is, market participants omit to settle part of their portfolios in the futures market and move these positions to the balancing energy market.

Let's consider the situation of a predictable positive balancing energy demand where the control area is in undersupply. To resolve this situation additional electricity has to be bought in the futures market. Equivalently, a predictable negative balancing energy demand could be resolved by selling electricity. Compared to a situation with no such predictable positions, a positive balancing energy demand is equivalent to a virtual supply in the futures market and a negative position results in virtual demand. Under the hypothesis of an absence of strategic balancing positions, the day-ahead market therefore settles at different prices. Positions otherwise withheld from the market will either directly or indirectly, by releasing capacity bound in other trades, be entered in the day-ahead market.

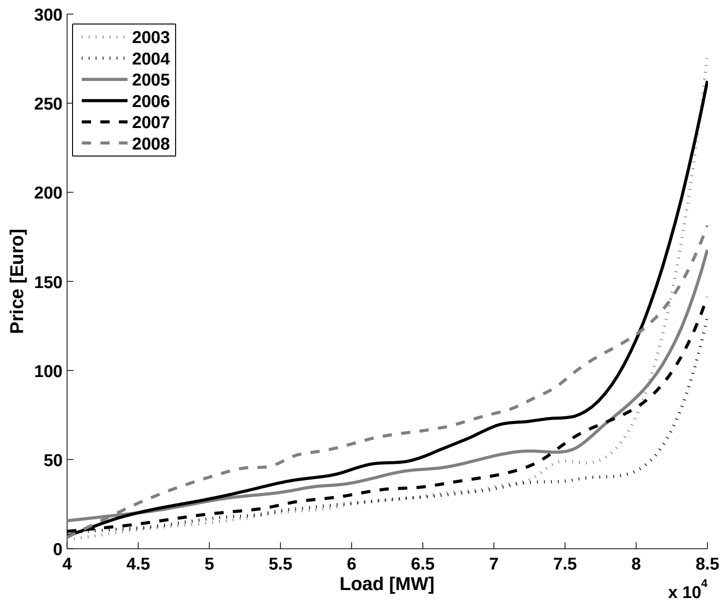
Möller *et al.* (2009a) identify incentives for such strategic positions in the balancing energy market, and provide a model to forecast these (see Section 3). We use these strategic positions and analyze the impact of this virtual supply and demand in the day-ahead market in a market simulation. For the purpose of this simulation we assign the virtual demand and supply induced by the balancing energy positions to the day-ahead market.

Our simulation is based on an adaption of the day-ahead market model used in Burger *et al.* (2004). In this model hourly electricity prices are estimated by an empirical price load curve (PLC) and a grid load measurement adjusted for availability. For a detailed description of the model we refer to Burger *et al.* (2004). In contrast to the original model, we adapt the model directly to the electricity prices rather than the logarithmic prices.

We estimate yearly average PLCs from load data published by the UCTE and hourly electricity prices at the EEX. Furthermore, the load data is adjusted for availability calculated from the monthly operation of base units as published by the UCTE. For the years 2003-2005 the load values are expanded from the published incomplete UCTE data set by transferring the seasonality of the 2006 to 2008 data. Additionally, we set a price spike of 1500€ at the thermal capacity limit. Figure 1 shows the estimated PLCs for the years 2003-2008.

Using these PLCs we extract an equivalent load time series from the data,

Figure 1: Estimated PLCs



also representing the short-term market situation. This equivalent load is used as a base scenario to simulate the market outcome disregarding the strategic balancing energy positions identified by Möller *et al.* (2009a) (see Table 3). To relate the balancing energy position to the adjusted load, the position has to be scaled by the demand fraction of 15% actually traded in the day-ahead market (see Michalk (2008)). So on average the balancing energy positions have to be scaled up by a factor of 6.7 to correspond to the load values the model is calibrated on.

The most dominant effect of the hourly pattern is reducing demand in peak hours and increasing demand in off-peak hours. Consequently, the price volatility is dampened. Furthermore, we observe a price reducing effect of this pattern

Table 3: Estimated price mark-up induced by strategic balancing energy deployment

	Hourly pattern			Long-term	Σ_{tot}
Year	Off-peak	Peak	Σ_h		
2003	0.0134	-0.0694	-0.0278	0.1291	0.1107
2004	0.0299	-0.0075	0.0125	0.0589	0.0692
2005	0.0192	-0.0322	-0.0045	0.0597	0.0294
2006	0.0269	-0.0296	-0.0008	-0.0050	-0.0087
2007	0.0084	-0.1171	-0.0538	0.0900	0.0267
2008	0.0366	-0.0825	-0.0191	0.0574	0.0258

in total. This is a consequence of the increasing slope of the PLC at high loads resulting in a stronger impact of the hourly pattern during high load peak hours. Here the year 2004 stands out with a positive total. This simple simulation does not allow analyzing this in detail, but it should be noted that there are more off-peak than peak hours and the estimated PLC is comparatively flat in 2004. This PLC reflects the absence of electricity price spikes in the day-ahead market in 2004.

The long-term deployment of balancing energy influences prices as well. However, these strategic positions continuously influence the day-ahead market in the same direction. Consequently, this effect dominates the total price impact of balancing energy in our analysis. In view of the detected long-term balancing positions the findings correspond to the average long-term positions in Table 1. In terms of the total impact the year 2003 shows to have the highest mark-up estimation in the sample. It indicates about 11% of the electricity price to be due to virtual demand induced by long-term balancing energy positions. This mark-up decreases gradually until it practically vanishes in 2006. The last two years show moderate mark-ups.

Due to the simplifications, the model can only provide an order of magnitude of the impact of balancing energy deployment, and we hold an in-depth analysis including availability and market share information on an hourly basis as essential to obtain quantitative sound results. Nonetheless, the results indicate the balancing energy market not only serves as an alternative marketplace to the day-ahead market, but also directly influences the day-ahead market.

To back up the identified impact of strategic balancing energy positions in the day-ahead market, we point to another investigation of the German day-ahead market. A brief study of EEX order book data revealed that a change in demand by as little as 135 MW could trigger a price increase of 23% or over 500€/MWh in a spike regime (see Ehlers *et al.* (2007)). These findings underline the relevance of positions in the order of hundreds of MW in the day-ahead market. It also gives a direct example of the detected hourly pattern being able to reduce spike risk. What is more, this strong influence of relatively small changes in demand underlines the need to amplify the assessed balancing energy demand when used in our market simulation that is adapted to total grid-load.

5 Balancing energy and market power

Our investigation of the impact of balancing energy positions in the day-ahead market reveals significant price alterations imposed by the long-term deployment. These long-term positions show particularly high levels of oversupplied control areas from 2003 to 2005 (see Table 1 and 3). The same period of time is also covered in three studies of market power (see London Economics (2007), von Hirschhausen *et al.* (2007), and Schwarz and Lang (2006)). As none of these studies take into account the influence of the balancing market, it suggest itself to analyze the error imposed by this simplification.

All studies apply a similar methodology: hourly market prices are compared to model prices derived from models based on fundamental market data. The data base on the other hand differs. Especially one study relies on a strong data base being provided with confidential company background by the EU commission (see London Economics (2007)).

The general criticism of all studies focuses on systematic errors imposed by the inherent model simplifications. One such example is neglecting scarcity pricing near the capacity boundary as done in all analysis discussed. Obviously, under this simplification the model price will be lower even when compared to a perfectly competitive market price. At this point we refer to Harvey and Hogan (2002), Ockenfels (2007), and Swider *et al.* (2007) for a detailed analysis of systematic errors. However, this example might illustrate how difficult a quantitative interpretation of results is. It is however plausible the influence of systematic errors is constant over time within one specific country and modeling approach (see Newbery *et al.* (2004)). In other words, while the absolute values are difficult to interpret and difficult to compare among the studies, the evolution of detected levels can be interpreted, as long as relevant boundary conditions are constant.

Following this interpretation we present the results of the three studies jointly using the price cost mark-up (PCMU), also summarizing the overall indication of the studies (see Table 4). The results of all studies are compatible within the same year. One should however appreciate the studies relay on a similar methodological approach. This holds especially for the studies von Hirschhausen *et al.* (2007) and Schwarz and Lang (2006). The studies indicate the highest mark-up in 2003. Furthermore the magnitude of the mark-up decreases from 2003 to 2005. The 2006 value is listed for the sake of completeness. However, the methodology and data source was changed in the corresponding analysis. Consequently, the assumption of constant boundary conditions is dubious for this value.

When compared to the average long-term balancing energy deployment in Table 1 a similar evolution is evident. In 2003 the control areas are in strong oversupply. This level of oversupply then diminishes in the following two years.

Table 4: Results of market power studies by comparison taken from Schwarz and Lang (2006), von Hirschhausen *et al.* (2007) and London Economics (2007)

Year	PCMU$_{S\&L}$	PCMU$_{vH}$	PCMU$_{LE}$	
2000	-0.06	-	-	o
2001	-0.09	-	-	o
2002	0.04	-	-	o
2003	0.40	-	0.59	++
2004	0.22	0.19	0.22	+
2005	0.15	0.14	0.15	+
2006	-	0.25*	-	+

As demonstrated in Section 4, the change in virtual demand in the day-ahead market effects electricity prices during this period of time in much the same way. The methodology of all three studies neglects the balancing energy market. It therefore constitutes a systematic error that is not considered in previous evaluations. In view of the systematically oversupplied control areas during the analyzed time period, all three studies show to be sensitive to this error.

In contrast to other systematic errors, the error of neglecting the influence of the balancing energy market could be interpreted as a sensitivity analysis of market power measurements. In such an approach an analysis run including balancing market induced demand would represent market power abuse, while the exclusion would represent an unbiased market. In fact von Hirschhausen *et al.* (2007) test their analysis in a similar way, approximating the level of additional demand required to explain their results in a perfectly competitive market environment in their model. As an example, a constant additional demand of 9 GW is estimated for the year 2004. For the same year the average long-term induced demand explains 30% of this additional demand. In the context of our analysis these studies of market power support the assessed impact of balancing energy positions in the day-ahead market.

6 Conclusion

The impact of strategic balancing energy positions in the day-ahead market clearly demonstrates the importance of viewing balancing energy as an integrated part of the electricity market in Germany. In the German market three strategies on different time scales are deployed.

Balancing energy is deployed over extended periods of time. These positions have a direct impact on electricity prices in the day-ahead market. In view of this impact, TSOs should not only be bound to a secure grid operation and network stability, but also take an active role in ensuring representative market prices in the day-ahead market. This is especially true because the distortion of prices imposed by long-term balancing energy positions is identified as market power abuse by relevant studies.

Looking at the quarter-hour and hour timeframes, two positive aspects should be considered further. On an hourly timeframe, the interaction of the balancing energy market and day-ahead market effectively reduces volatility in the day-ahead market. Thereby, the balancing energy market contributes to mitigate the effects of electricity price spikes.

On a quarter-hourly timeframe, electricity portfolios can be adapted to counter balance predictable fluctuations. This strategy corresponds to the deployment of capacity reserve. By this the balancing energy market provides an additional marketplace to trade capacity reserve. Compared to the reserve capacity market, the balancing energy market is technically less demanding, and therefore, potentially attracts further reserve capacity into the market. This point is particularly relevant in the context of demand side management capacity, where operational constraints of potential facilities are diverse.

In view of an intent extension of renewables with their often weather-dependent availability, these two aspects may gain further relevance in the future.

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