[*BALANCING MARKETS PERFORMANCE AND ASSOCIATED COSTS: EVIDENCE FOR THE ITALIAN MARKET*]

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Overview

Balancing markets sessions have become extremely relevant in the last years, when electricity production from renewable resources (RES-E) has increased substantially. This situation is common to the majority of EU countries and it is the result of generous supporting policies to support RES deployment. Now RES-E occupy a large portion of the day-ahead market supply, due to priority despatch, at the expense of conventional technologies. Since RES-E production is variable and to some extent impredictable, real time balancing is essential for the functioning of the system.

Balancing sessions are dominated by conventional technologies (thermal, hydro and water pumping), which have the required degree of flexibility. Units supplying regulation services usually enjoy a higher degree of market power in balancing than in day-ahead sessions, where they compete with RES producers. For this reason, in the last years the lower margins gained on the day-ahead market may have changed the opportunity cost for thermal plants to participate to less competitive balancing sessions.

Some recent analyses have evaluated the so-called merit order effect driven by less expensive RES-E production in day-ahead market and somewhat quantified savings in terms of lower system marginal price. Less attention has been devoted to the calculation of costs associated with balancing activity, which represents the other side of the coin of RES-E production.

We analyse the largest portion of the Italian market, i.e. the North zone, characterized by a large penetration of solar PV technology in the last few years. In Italy, the balancing activity is organized in two markets: MSD is the planning session and MB is the real time session. Both are managed by the Italian TSO (TERNA) who buys and sell electricity for up and down regulation from a small set of units having the required degree of flexibility.

The quantification of costs incurred for planning and dispatching balancing power has very interesting policy implications and there is an ongoing debate in many coutries about the possible sources of balancing cost increase with the aim of providing new market rules and monitoring. In our analysis we conduct this exercise at a very high disaggregation level taking into account hours, technologies and market purpose.

Methods

Cost analysis. Balancing costs are calculated and disaggregated for time, purpose and technology.

We controlled for load considering some specific hours of the day: H3 (minimum demand), H9 (morning ramp), H11 (morning peak), H13 (maximum solar production), H19 (evening peak with decreasing solar production), H21 (evening ramp-down).
We use data of accepted bids for up and down-regulation and we calculate weighted prices for each technology: hydro, water pumping and thermos.

Time-series analysis applied to accepted bid data in balancing sessions for the Italian North zone in different hours of the day. We conduct a dynamic analysis (using impulse response function technique) on accepted bids in balancing sessions to estimate the effects on prices induced by shocks hitting the different technologies using RES quantities and fuel prices as the main drivers.

We compare the dynamics across specific hours in two samples. We consider years 2006-08 characterized by low RES penetration and years 2013-15 with significant RES penetration.

Results

We find that balancing quantities decreased from the first to the second sample, a result that suggests how increasing RES penetration does not necessarily imply increasing balancing needs for the system. The same result has been obtained for the German market, according to Hirth and Ziegenhagen (2015). For Germany however, the decrease in balancing needs has coupled with a decrease even in balancing costs. On the contrary, aggregating accepted bids for technologies and market purpose (up or down regulation) across hours, we find that balancing costs increased in the Italian case in the sample 2013-15 (characterized by high RES penetration) with respect to 2006-08 (low RES penetration).

To shed light on this result we calculated some statistics of accepted bids and offers for each technology and hour.

For down-regulation services, we find that the average of yearly mean prices decreased for each technology across samples. Completely different dynamics are observed for the sale of up-regulation power. We notice quite different trends for mean and maximum prices both in MSD and in MB, with noticeable increase in bids for thermal balancing power especially at hour 13 and 19. Hydro power sets maximal bids at hours 19 and 21.

We then compute balancing costs as product of awarded prices and corresponding awarded quantities at unit level. In this way, we obtain disaggregated costs for technologies, hours and market purpose.

We observe that revenues accruing to the TSO from down-regulation decreased for all hours over the second sample, in particular for hydro and water pumping, whereas we observe moderate reductions for thermal power.

On the cost side (up-regulation) we register a substantial cost decrease from the first to the second sample for energy bought from water pumping. On the contrary, there is an unclear overall trend for hydro and thermal power, with a noticeable increment of costs in 2015 with respect to 2014. Cost increase occurs for specific technologies and hours, suggesting evidence that the increase in balancing prices is originated from operators' bidding strategies related to their degree of market power.

Time series analysis shows that balancing prices dynamics appears to be influenced by technologies/fuels, but only in specific hours/market conditions. Morning and evening ramps appear to be particularly prone to shocks due to the increase/decrease of solar PV production.

Conclusions

There is an ongoing debate about the supposed increase in balancing needs and hence costs induced by the high RES penetration registered in the last decade.

This paper has analyzed in great detail the situation in the North zone of the Italian electricity market and contributed to the literature in two ways. First, we have shown that balancing quantities have decreased (as in Germany) after the massive introduction of RES-E production. Secondly, we have calculated balancing prices and costs for up and down regulation disaggregating data for each technology. We found a significant cost increase especially for up-regulation.

We emphasize that the exercise of calculating costs for technologies, hours and market position of the TSO helps understanding the real market dynamics and allows to better tailor any regulatory intervention.

In this manner we were able to detect very interesting effects related to possible bidding strategies open to bidders competing in a very concentrated market. We detected differential bidding strategies of producers, especially thermal but also hydro units, which were able to exploit their pivotal position at sunset when PV units stop production.

References

Hirth, L. & Ziegenhagen, I.,Balancing power and variable renewables: Three links, *Renewable and Sustainable Energy Reviews* , **2015**, *50*, 1035 – 1051.