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**INTEGRATION OF RENEWABLE GENERATION
AND COGENERATION IN MIBEL
AND IN THE OPERATION OF THEIR ELECTRICAL SYSTEMS**

EXECUTIVE SUMMARY

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*INTEGRATION OF RENEWABLE GENERATION AND COGENERATION IN MIBEL
AND IN THE OPERATION OF THEIR ELECTRICAL SYSTEMS*

1 INTRODUCTION AND MOTIVATION

The Iberian Electricity Market (MIBEL) became fully operational on 1 July 2007, culminating a joint work of the Portuguese and Spanish Governments begun in 2001, embodied in the International Agreements of Santiago and Braga¹, and intensified in the first semester of 2007, following the Luso-Spanish summit in Badajoz of November 2006, in which both Governments defined a set of goals for the consolidation of MIBEL.

In the course of the ensuing interaction between Iberian regulators and the Iberian transmission system operators, Rede Eléctrica Nacional (REN) and Red Eléctrica de Espanha (REE), the need for a study on the treatment of renewables was identified. The purpose of the study is to examine the regulatory harmonisation, both existing and any that may be needed, to foster the integration of generation from non-fossil renewable sources, such as wind, solar and mini-hydro, high-efficiency cogeneration and waste treatment under MIBEL.

In Portugal, energy from these sources, excluding large hydro, is known as Special Regime Production (PRE²). In Spain, these same sources used the same designation until the entry into force of Ley 24/2013 of the Electricity Sector, of 26 December. For the purposes of simplicity, the PRE term is used when referring to both countries.

Although the regulatory framework differs in each country, having been changed in Spain during the period under analysis, in general terms, PRE refers to electricity generated by certain technologies for which regulation grants special conditions of operation and retribution, with the aim of promoting their development and enhancing the benefits they bring to the environment. In particular, PRE is part of a specific regulated retribution scheme with a certain time horizon, which is an alternative and / or complement to the income obtained on the wholesale market, in competition with other technologies.

This executive summary of the study on “Integration of renewable generation and cogeneration in MIBEL and in the operation of their respective electrical systems” addresses several features related to PRE and its integration in the operation and functioning of systems and the market, from the guiding principles of security of supply, the effectiveness of the commitments to environmental sustainability and the economic efficiency imposed by an economic situation marked by austerity and the needed improvement of competitiveness.

¹ Internacional Agreement on the establishment of the Iberian Electricity Market between the Kingdom of Spain and the Portuguese Republic, on 1st October 2004, signed in Santiago de Compostela (the Santiago Agreement); and the Agreement that changes the previous one, signed in Braga on 18th January 2008 (the Braga Agreement).

² PRE – the translation in Portuguese / Spanish is *Produção em Regime Especial / Producción en Regimen Especial*

2 CONCLUSIONS

In planning its activities, the MIBEL Board of Regulators set itself the goal of conducting a study on the integration into the market of the special regime production. The present document fulfils this objective and constitutes, at the same time, the second consideration of this concrete reality – following the study undertaken in 2012.

As a complex reality, from technical and economic perspectives, the integration of special regime production in the context of MIBEL is of high importance, due to the relative size of this phenomenon in the context of the Iberian peninsula, with few other similar examples in the European context. It should also be noted that the study also has an analytical dimension that is not limited to MIBEL, with a view to the integration of MIBEL itself into the European energy market, particularly as a result of the development of the integration with the French market.

From the study and the analysis carried out, it can be concluded that, as regards the price formation on the MIBEL spot market there seems to be a high inverse relationship between the relative weight of the special regime production in covering demand and the level itself of the market price. Indeed, considering the high availability of PRE resources (whose contribution covers 2/3 or more of demand), the MIBEL spot price tends to approach values ranging from 0 €/MWh to 30 €/MWh, clearly below the average marginal cost values that can be estimated for the other technologies.

Inversely, the low availability of PRE resources is associated with a higher occurrence of prices above 60 €/MWh, which reflects the need to use higher marginal cost technologies in order to meet demand in MIBEL.

The arguably highly relevant impact of the weight of PRE in the MIBEL spot price formation cannot be considered surprising, as this type of generation generally benefits from priority dispatch and guaranteed administrative tariffs, which implies that its participation in the spot market is done as an instrumental bid offer in order to guarantee that dispatch. Nevertheless, as the proportion of supply that is placed as an instrumental bid offer increases, one observes that the volatility of the market price will approximate the relative volatility of the respective resource placed in this price referential - that is, the greater the proportion of PRE placed at instrumental bid offer, the greater the tendency to have price variability in the spot market.

In this context, an increase in the renewable generation that participates directly in the market, without benefiting from a guaranteed administrative tariff, may contribute to some stabilization of the conditions of price variability in the spot market. However, the existence of a significant share of renewable energy in MIBEL with very low variable costs leads, in any event, to a strong price variability, even if the guaranteed administrative tariff disappears.

In the analysis carried out to illustrate the presence of the special regime production in MIBEL, which is structuring for its integration into the market, it is important to evaluate its intrinsic features from an operational perspective, taking into account that the combined special regime production in MIBEL is strongly marked by the significant relative weight of wind generation, compared to other primary energy

sources. Such configuration determines that the time variability features of the special regime production volumes are, to a large extent, influenced by the variability features of wind generation itself.

Analysis of the forecast and firmness of the special regime production confirm the intermittent features attributed to this type of electricity generation; with the study identifying that there are some distinctions between Portugal and Spain. Indeed, comparing the temporal variability of wind generation in Portugal and Spain, it can be observed that this generation is more volatile in Portugal than in Spain - which is reflected in a higher average standard deviation in Portugal. Due to the weight of wind generation in the aggregate of special regime production, this greater volatility leads to a greater difficulty in forecasting the phenomenon and, consequently, to a lower predictability of wind energy forecasts in Portugal. As an explanation for this difference, we can mention the greater geographical complementarity of wind generation in Spain, which contrasts with the strong influence of Atlantic winds in Portugal, which does not allow such complementarity. This necessarily results in a greater complexity of the integration of PRE in the Portuguese market, when compared to what happens with the sum of wind farms in Spain.

With regard to the treatment of imbalances, both with respect to the overall imbalance of each system and the specific imbalance that can be attributed to the combined PRE, the study illustrates the following:

- In Spain, for the Spanish peninsular system as a whole, a trend of a slight reduction in the magnitude of the average hourly imbalance is observed between 2010 and 2015. In addition, for the combined PRE in the same period, it is possible to observe a decrease in the magnitude of the imbalance attributable to the PRE, which slightly exceeds the evolution that can be observed for the whole system.
- In Portugal, for the national electricity system, in the same period between 2010 and 2015, there is a slight tendency towards an increase in the average hourly imbalance, which contrasts with a tendency, albeit slight, to reduce the imbalance attributable to the PRE.

From the above, it could be seen that the evolution of the treatment of PRE imbalances, both in the Portuguese system and in the Spanish system, showed more positive evolutions than what occurs for each one of the systems considered generally. In this sense, it can be said that, during this period, the conditions for integration of PRE in the market were improved, with lower real-time impacts at operational uncertainty level.

Nevertheless, it should be noted that the treatment regimes of the PRE in Portugal and Spain remain distinct - as was noted in the study of the MIBEL Board of Regulators of 2012 - with the special regime producers in Portugal that benefit from an guaranteed administrative tariff being exempt from any charges in respect of their imbalances.

Regarding the technical operation of the systems, the study showed that, for Portugal and Spain and between 2010 and 2015, there is a decrease in the needs for secondary reserve regulation band which, nonetheless, is more expressive in Portugal than in Spain.

It should be recalled that since June 2014 the BALIT (Balancing Inter TSO) mechanism for the exchange of cross-border balance energy services, corresponding to reserve energy, has been in operation between the systems in the South-western Europe region, providing an increase of the reserve volume offered by the transmission system operators. The implementation of the TERRE project (Trans European Replacement Reserves Exchanges) is expected to be extended to more countries based on a multilateral exchange model that will contribute to an improvement over the already implemented mechanism.

Given that the start-up of the BALIT project dates back to June 2014, this decrease in the need for secondary reserve regulation over the period is only partly explained by the reinforcement of coordination mechanisms among the Iberian transmission system operators. It could be inferred that given the weight of the aggregated PRE in the Iberian system, the decrease in the magnitude of the imbalances attributable to this aggregate could have contributed positively to this evolution.

The first conclusion that can be drawn from the behaviour of MIBEL's internal interconnection is the consistent occurrence of market integration, measured by the high number of hours in which the price is equal (null spread) in the two MIBEL bidding zones (more than 90% of the hourly occurrences between 2010 and 2015), reflecting a very reasonable integration capacity of the aggregated PRE and, on the other hand, the very similar magnitude in Portugal and Spain of the relative size of the combined PRE covering the demand.

The analysis of the management of MIBEL's internal interconnection showed that the occurrence and evolution of price differentials (price spreads) between the Portuguese and Spanish bidding zones is more influenced by the evolution of the relative weight of hydroelectric generation than by any other variable. In fact, the evolution of the relative weight of hydroelectric generation in Portugal (a system more dependent on this energy source, in particular on run-of-river hydro power plants, than the Spanish system) seems to determine the inversion of price spreads between the two systems - price in Spain higher when there are high levels of water availability in Portugal and higher prices in Portugal when the reverse is true.

However, although it may be observed that the occurrence and magnitude of price spreads between Portugal and Spain remains relatively unrelated to the level of contribution of PRE (with values of relative weight of the PRE in the MIBEL global demand between 53% and 55%, the price spreads can vary between 0 €/MWh and 5 €/MWh in any of the directions), even for the contribution levels of the PRE above that threshold there seems to be a trend towards the occurrence of more significant price spreads, in particular for Portuguese imports. These data thus illustrate the lower resilience of the Portuguese system to the integration of high levels of PRE when they occur simultaneously with lower absolute demand values.

Regarding the capacity constraints that occurred in the Spain-Portugal interconnection, the MIBEL Board of Regulators considers, as already indicated to the Spanish and Portuguese Governments in 2013, that advancing with the regulatory harmonization of curtailment procedures of special regime production in both countries is a priority, in order to eliminate these reductions that affect the correct functioning of the MIBEL. The MIBEL Board of Regulators considers that these interconnection capacity reductions should not occur, in accordance with the proposed revisions to Article 11 (5) of the Electricity Regulation of the Clean Energy

Package launched by the European Commission in November 2016, which points out that the priority of renewable energy dispatch should not be used as a justification for constraining cross-border interconnection capacities.

Regarding the analysis of the operation and effects of the external border of MIBEL (the interconnection between the Spanish and French systems) - the analysis carried out in the study confirms the empirical approach that reinforcing the interconnection capacity will contribute to facilitating the market integration of special regime production. Indeed, contrary to what was observed for the internal interconnection of MIBEL, the variation of the relative weight of the PRE covering market demand seems to have a more direct relation with the formation of price spreads between Spain and France and with the direction of the flows. In particular, there seems to be enough evidence that, for high PRE generation availability in MIBEL, energy export flows are registered and, given the interconnection capacities, corresponding higher price spreads are generated (price in Spain below than the price in France).

The analysis carried out for the external interconnection of MIBEL, when combined with that produced for the internal interconnection, leads to the conclusion that the reinforcement of market integration on a scale beyond Iberia - as well as the reinforcement of the interconnection capacity with France – has implications beyond this frontier, spreading to all interconnected systems.