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Renewables versus efficiency. A comparison for Spain

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Abstract

Along the last decades, renewable energy (especially wind) in Spain has undergone a significant development (lead by a small group of renewable promoters supported by institutional policies), contributing significantly to electric generation mix (42.8% renewable in 2014). On the contrary, the promotion of energy efficiency actions (accomplished by a large number of industrial and domestic consumers that are very poorly supported by energy policies), are still little explored. According to ODYSSEE-MURE, energy efficiency at the EU-28 level improved by 1.2%/year on average from 2000 to 2013, while for the case of Spain, the rate of improvement was only 0.6 %/year on average throughout that period (the lowest rate of energy efficiency improvement in the EU-28).

This work seeks to compare the integration of renewable production with energy efficiency plans, in order to advance their potential economic impact in the wholesale market and consumers. To reach that goal, the hourly market data retrieved from the Spanish/Iberian Market Operator (OMIE) for 2014 will be used as a base. Then, a set of pseudo-heuristic scenarios with integration of renewable production and energy efficiency (load saving) will be elaborated and analyzed to quantify what are expected to be the main effects on the Spanish electricity market and consumers.

The results will show that energy efficiency exhibits the best performance in terms of economic efficiency (less cost of the traded energy) and environmental sustainability (greater replacement of fossil fuels).

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Electricity markets; Renewable energy; Energy efficiency; Merit-order effect.

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1. Introduction

Over recent years there has been a significant effort in the electrical systems of the EU countries and many others worldwide, to fulfill the mandatory commitments derived from the Kyoto Protocol and its successors [1,2]. Thereby, the generation fleet has diversified significantly in terms of technology generation, mainly due to large-scale integration of production based on renewable energy. Consequently, electrical systems are evolving towards a generation fleet that is much more diverse, dispersed and decentralized, with a much larger number of generators, in which the renewable generation has a significant and growing share.

The reduction of the demand via the promotion of load saving programs or the enactment energy efficiency policies could also be another less explored tool to accomplish the commitments from the Kyoto Protocol. In fact, there exist a certain synergy between energy efficiency and renewables since when the demand decreases, a fixed amount of renewable production gives place to a greater share of renewables on the generation mix. In any case, most counties have chosen the development of renewables as a means to fulfill its environmental commitments.

This is the case of Spain where along the last decades, renewable energy (especially wind) has undergone a significant development. This growth has been led by a relatively small group of renewable promoters supported by institutional policies, and have made renewables to be a significant contributor to electric generation mix (42.8% renewable, 20.4% wind in 2014 [3]). On the contrary, the promotion of energy efficiency actions, accomplished by a large number of industrial and domestic consumers that are very poorly supported by energy policies, still are little explored. According to ODYSSEE-MURE [4], energy efficiency at the EU-28 level improved by 1.2%/year on average from 2000 to 2013 (about 15% over the period). However, the pace of progress has slowed down since the economic crisis: the annual gain between 2000 and 2007 has dropped from 1.3%/year to 1%/year between 2007 and 2013. For the case of Spain, energy efficiency only improved on average by 0.6 %/year throughout that period, which is the lowest rate of energy efficiency improvement in the EU-28. Moreover, energy conservation policies seem especially well suited for Spain due to its high level of energy dependence. According to Eurostat [5] the Spanish rate of gross energy dependency is always much higher than that of the EU average. For 2013, the level of gross dependence of Spain was 70.5% in 2013, well above the 53.2% of the UE average.

This work seeks to compare these two approaches for the Spanish case: the integration of renewable production and the development energy efficiency programs, in order to advance their potential impact on the electricity market. With this purpose, first a qualitative model, based on the linearization of the wholesale market around the clearing point, is used to examine some basic hypotheses. An appropriate set of empirical-based scenarios with renewables and energy efficiency are then generated from the retrieved historical information of the Iberian/Spanish Market Operator (OMIE) for the year 2014, in order to quantify the main effects on the market. The content of the paper is as follows. After the introduction, the Spanish/Iberian electricity market is briefly described and a qualitative model, based on the linearization of the market, is used to examine some basic hypothesis regarding the expected effects of renewables and energy efficiency. The hourly merit-order generation and demand curves throughout 2014, retrieved from the archive of the Market Operator (OMIE) are then used as source data for the generation of realistic renewables and energy efficiency scenarios. The main potential effects of renewables and energy efficiency on the market are then quantified and analyzed. Finally, the paper closes with the main findings of the comparison.