The Merit-Order Effect of Energy Efficiency

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Abstract

The integration of certain amount of renewable generation in the wholesale market right-shifted the merit-order generation curve, which produces a noticeable reduction of the clearing price while slightly increases the traded energy (almost inelastic demand curve). The downward pressure on the clearing price is mainly due to the fact that the introduction of renewable generation bids with very low (even null) marginal cost, displaces to the right all kinds of conventional technologies (with higher marginal cost), including the technology which would otherwise have set the clearing market price. This right-shifted displacement of the merit-order generation curve leads to a lower wholesale clearing price, a small increment of the traded energy and a reduction of the total cost of the traded energy in the wholesale market. This is the key mechanism and its main effects on the market of the very well-known merit-order effect of the renewables. The promotion of energy-efficiency plans (industry and domestic) by policy-makers is expected to yield a reduction of the demand. As a result of the reduction of demand bids, the merit-order demand curve would experience a left-sifted displacement, which would produce a reduction of both the clearing price and the amount of traded energy. Consequently, the total cost of the traded energy also would diminish. As can be seen, the parallelism of the main effects on the market between the integration of renewable and energy efficiency evidences the existence of what can be called the merit-order effect of energy efficiency. To analyze the characteristics of this merit-order effect of the energy efficiency, a simplified model, based on the linearization of the market around the clearing point, is developed. This simplified model is also used to compare the merit-order effect of energy efficiency and renewables. A set of scenarios with energy efficiency and renewables have been generated in order to quantify the main effects on the Spanish/Iberian market for the year 2014.

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

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1. Introduction

Once the supply and demand bids have been elaborated and submitted by the corresponding generation and demand agents, the Market Operator elaborates, for every hour of the day-ahead, a merit order dispatch by ordering the supply bids in ascending price order and demand bids in descending order. After that, and simplifying the complex optimization process that takes place, the Market Operator carries out the matching clearing point by the intersection of the merit order supply curve with the demand curve.

Since renewable generators extract the energy from a natural source (wind or sun, e.g.), they can produce electric power with very low operating costs. This allows renewable generators to submit their bids offering energy at very low (even null) marginal cost.

The methodology of elaboration of the merit order generation dispatch made that when a renewable generator offer a bid with certain amount of energy at very low cost, the Market Operator inserts the renewable bid by right-shifting the merit order generation/sale curve. This right-shifting produces a noticeable reduction of the clearing price while only slightly increases the traded energy, due to the characteristic lack of elasticity of the demand/buy curves.

As can be seen the downward pressure of the renewable generators on the clearing price is mainly due to the fact that the introduction of renewable generation bids with very low (even null) marginal cost, displaces to the right all kinds of conventional technologies (with higher marginal cost), including the technology which would otherwise have set the market clearing price. The integration of renewable induces a displacement of the operating point of the wholesale market towards a lower clearing price, a small increment of the traded energy and, as a consequence, a reduction of the total cost of the traded energy in the wholesale market. This is the key mechanism, and its main effects, on the market of the very well-known merit-order effect of renewables. The avoided amount of burned fossil fuel and the consequent reduction of CO_2 emissions due to the shifted fossil fuel generation leads to a secondary mechanism for reducing the clearing price of energy, as the reduction of the demand of fossil fuel and CO_2 emission allowances reduces the demand of both the fuel (in the international market) as well as of the CO_2 emission allowances, putting a downward pressure on its prices and thus reducing the costs of the remainder cleared fossil fuel-based generators.

The interest of consumers (industry and domestic) to reduce their energy bills and the promotion of energy-efficiency plans by policy-makers is expected to yield a reduction of the demand. As a result of the reduction of demand bids, the merit order demand/buy curve would experience a left-shifted displacement, which would produce a reduction of both the clearing price and the amount of traded energy. Consequently, the total cost of the traded energy would also diminish. Again, the avoided burning of fossil fuel and CO_2 emissions due to the fossil fuel not required lead to a secondary via for reducing the clearing price of energy, as this reduces the costs of the remainder cleared fossil fuel-based generators.

As can be seen, the parallelism of the effects on the market between the integration of renewable and energy efficiency demonstrates the existence of what could be called the merit-order effect of energy efficiency. This work seeks to analyze the characteristics of this merit-order effect of the energy efficiency and carry out a comparison with the corresponding characteristics of the merit-order effect of renewables. To achieve that purpose, a simplified model, based on the linearization of the market around the clearing point, will be used to explore some basic conjectures. Then an appropriate set of empirical-based scenarios with energy-efficiency as well as integration of renewables have been generated from the retrieved historic information of the Market Operator (OMIE) for the year 2014, in order to quantify the main effects on the Spanish/Iberian market. After the introduction, the content of the paper is as follows. First the Spanish/Iberian electricity market is shortly surveyed and a simplified model, based on the linearization of the market around the clearing point, is used to check some hypothesis regarding the expected effects of energy-efficiency and renewables. Next, the hourly merit-order generation and