Abstract

Thanks to growing environmental concerns, renewable energies take a higher and higher share of electricity generating portfolios. In Germany particularly, the installed capacity of wind and solar plants has increased continuously for the past ten years. Given the principle of the merit-order dispatch, a greater use of wind and solar power allows the electricity spot prices to drop significantly. However, wind and sun are both intermittent resources, and this leaves great room for uncertainties on prices. As a consequence, prices become much more dependent on the weather conditions and show greater volatilities, making hedging much more difficult. At the same time, the mechanism of market coupling in the Central West Europe (France, Germany, Benelux) goes toward a harmonization of prices. As such, the cross-border interconnections play a decisive role in the electricity pricing.
This paper deals with the actual influence of the interconnections between France and Germany on electricity spot prices when renewable energies are added to the energy mix. A model of a French-German market is made in order to see the impact of an increasing penetration of renewable energies on spot prices. The wind and solar generations are modelled using artificial neural networks, ANN. Multiple linear regression is employed to model the French and German loads. The cross-border interconnections are modelled based on the capacity allocations published by RTE (the national French grid operator) and finally the French and German prices are modelled with a GARCH process to study the volatilities. The study is made for three different scenarios: the reference scenario, with a penetration of renewable energies as seen in 2012, a 2020 scenario, with a penetration of renewable energies as predicted in 2012, and a 2020 scenario with increased interconnection capacities between France and Germany.
Running the models shows that a higher penetration of renewable energies lowers spot prices in average, but introduces price spikes that did not exist beforehand. On short periods of observation, the volatility seems to decrease, but on longer periods, the spikes increase the volatility. Also, increasing the interconnection capacities does make the prices converge, but to a certain extent only.
Finding fitting hedging strategies becomes more delicate when prices vary with such uncertainty. The study could be more developed (by extending it to the whole European continent) in order to get a more accurate vision of how energy markets will look like in a few years. However, it must be understood that the future scenarios depend on many variable factors, and no mathematical model is able to capture all those factors accurately.