

# ***RISK-AVERSE INVESTMENT IN ENERGY-ONLY MARKETS***

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## **Overview**

Electricity markets are recently faced with the problem of less incentive for investment in new capacity for the near future. The main reason is that the current market design makes difficulties for almost all producers and in particular for marginal producers to recover their capital costs. This problem is known in the literature as resource adequacy or supply security problem. Increasing share of low marginal cost renewables, decreasing market prices, unclear future energy policies, limited demand elasticity and lack of storages are some of the reasons that exacerbate the resource adequacy problem. In this study, the main question is to estimate the impact of risk-averse investment on the resource adequacy condition in a competitive energy-only market. So, the optimal scarcity duration and optimal reserve margin is calculated in an energy-only market in presence of both risk-neutral and risk-averse investors.

## **Method**

The proposed energy market model probabilistically evaluates resource adequacy conditions by simulating the uncertainty both in the generation and demand side of the market. This approach comprehends the dynamics of interactions between the energy market components such as price, supply, demand, profitability and investment decisions. Regarding the uncertainty in generation side, the intermittency of renewables production and regarding the demand side uncertainty, the impact of load forecast error and weather uncertainty are analyzed. Then, we implement a Monte Carlo analysis over a large number of scenarios with varying demand and supply conditions in order to examine a full range of potential economic and reliability outcomes. The risk-aversion is measured by the conditional value at risk (CVaR). The optimal investment in new capacity is calculated by considering the expected profitability associated with all possible outcomes in future.

## **Results**

In this paper, the case study is the German energy-only market with a perfect competition. This market is analyzed from 2015 to 2035 by considering the increasing share of solar and wind generation. As mentioned, the uncertainty is considered in both generation and demand. It is assumed that the investors have complete information about all players in the market and they decide to invest if and only if it is profitable. Our analyses represent the expected long-term condition in the German energy-only market when investors have different level of risk-aversion. We analyze the interrelationships between scarcity prices and reserve margin and risk-aversion. The preliminary results show that the risk-aversion has a positive correlation with the frequency of scarcity situation. Also, it is shown that the higher risk-aversion results more utilization of the price-sensitive loads in a fixed demand response capacity.

## **Conclusions**

In this study, the optimal and efficient price and investment for an energy-only market structure is derived in which investment decisions are made under different risk-aversion scenarios. Then, the resource adequacy condition is compared under the achieved optimal price and investment planning in the defined scenarios. The German electricity market is studied as a case study and the optimal prices and investment patterns are discussed. The preliminary results show the correlation between the risk-aversion and frequency of scarcity situations and their impact on the optimal reserve margin.

## **Reference**

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