Renewable generation expansion under different support schemes: a stochastic equilibrium approach

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Abstract— Following the deregulation of electricity markets, a current challenge of policy makers is to facilitate the transition to a sustainable power system at the highest welfare for society. In this paper we investigate the efficiency of diifferent support schemes, such as a feed-in tariff, a feed-in premium and tradable green certificates, with respect to incentivizing the required investments in renewable generation. We consider a number of generation expansion problems, and formulate stochastic equilibrium models that account for uncertainty in demand and renewable supply, the risk-aversion of investors and the competitiveness of the market. The problem of the policy maker is formulated as a mathematical program with equilibrium constraints (MPEC) and as a non-linear complementarity problem (NCP) for the feed-in schemes and the certificate market, respectively. Our models are solved for a small illustrative example and a larger case study based on the Danish power system.
The results confirm that the main driver for the optimal choice of renewable support scheme is the aversion of power producers towards price and volume risk, while the competitiveness of the market rarely affects such choice.

Index Terms— Generation expansion equilibrium, renewable target, support scheme, risk-aversion, stochastic programming.