

Competition and Cooperation of Prosumers in Cournot Games with Uncertainty

Authors : Yong-Heng Shi, Peng Hao, Bai-Chen Xie

Abstract : Solar prosumers are playing increasingly prominent roles in the power system. However, its uncertainty affects the outcomes and functions of the power market, especially in the asymmetric information environment. Therefore, an important issue is how to take effective measures to reduce the impact of uncertainty on market equilibrium. We propose a two-level stochastic differential game model to explore the Cournot decision problem of prosumers. In particular, we study the impact of punishment and cooperation mechanisms on the efficiency of the Cournot game in which prosumers face uncertainty. The results show that under the penalty mechanism of fixed and variable rates, producers and consumers tend to take conservative actions to hedge risks, and the variable rates mechanism is more reasonable. Compared with non-cooperative situations, prosumers can improve the efficiency of the game through cooperation, which we attribute to the superposition of market power and uncertainty reduction. In addition, the market environment of asymmetric information intensifies the role of uncertainty. It reduces social welfare but increases the income of prosumers. For regulators, promoting alliances is an effective measure to realize the integration, optimization, and stable grid connection of producers and consumers.

Keywords : Cournot games, power market, uncertainty, prosumer cooperation

Conference Title : ICAE 2023 : International Conference on Applied Energy

Conference Location : Tokyo, Japan

Conference Dates : April 17-18, 2023