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PARTICIPATION OF RENEWABLE ENERGY SOURCES IN ELECTRICITY MARKETS

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The electricity industry has seen rising penetrations of nondispatchable renewable energy sources (RESs). This has historically been driven by policy mandates, such as subsidies or renewable portfolio standards. Analysing the effects of increasingly growing RESs on electricity market equilibrium is a crucial task, letting the policy makers, market designers and regulators to examine market rules and structures and to refine market designs with the aim of maximizing the efficient accommodation of RESs in electric power systems and markets. To this end, a bi-level multi-period modelling of market equilibrium in presence of high penetration of RESs is proposed and studied and its results would be presented in the talk. Market interactions between storage, wind, and conventional units under a variety of market and ownership structures are examined using the proposed bilevel equilibrium framework. The proposed model is applied to different case studies with a number of market and asset-ownership structures. This includes cases in which energy storage and wind are price-taking or price-making and variety of equilibrium are found ranging from extremely collusive to competitive outcomes. Obtained results show that rising penetrations of RESs in electric power systems can raise different challenges like suppressing wholesale energy prices by displacing higher-cost conventional generation from the merit order. Wind suffers disproportionately from this price suppression, because the price is most suppressed when wind availability is high, hindering wind-investment incentives. The increasing need for dispatchable generation with fast-ramping capabilities is known as inefficiency caused by the high variability of renewable generation. Based on the results, in a market with strategic price-making firms, energy storage is a preferred solution to these inefficiencies. Regarding variety of structures considered for participation of energy storage, a market structure in which renewable generation and energy storage are co-owned is the most efficient in terms of integrating renewable energy.

Biography

Ali Shahmohammadi has received his BSc and MSc degrees (with Honours) in Electrical Engineering from Shahid Beheshti University, Tehran, Iran, in 2009 and 2011, respectively, and his PhD degree in Electrical Engineering from University of Tehran, Tehran, Iran, in 2018. He was a Research Scholar on a project entitled Participation of Renewable Energy Sources in Electricity Markets in the Integrated Systems Engineering Department at The Ohio State University, Ohio, USA, from 2015 to 2016. He was awarded the Visiting Scholar Fellowship during the PhD program from Ministry of Science, Research and Technology of Iran in 2015 and also was awarded as an exceptional talent during the PhD program from National Elites Foundation of Iran in 2016 to 2017. His research interests include Energy Management, Restructuring and Electricity Markets, Renewable Energies, and Smart Grids.

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