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A two-stage IGDT-stochastic model for optimal scheduling of energy communities with intelligent parking lots

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Abstract-

The proliferation of green mobility will bring multiple benefits to the society; however, it may be counterproductive for power systems if its integration is not properly planned. In this context, Intelligent Parking Lots have emerged as a valuable paradigm for integration of electric vehicles into energy systems. This framework consists of a set of vehicles that are managed as a whole and makes possible to exploit them as large storage facilities through their vehicle-to-grid capability. This particular feature may be significantly advantageous for energy communities since they can exploit parking lots as collective storage systems. In this paper, a two-stage optimal scheduling framework has been developed for optimal scheduling of energy communities. The proposal uses a stochastic representation of the state-of-charge of the lots with the end of accounting for random behaviour of uncertainties. On the other hand, the uncertainty of the upstream energy market is dealt with Information Gap Decision theory, resulting in an original hybridization that allows to adopt a risk-averse strategy by the operator. The optimization problem is formulated as a Mixed-Integer Linear programming model that can be efficiently solved by average solvers. A case study is performed to validate the new proposal and analyse the role of Intelligent Parking Lots in energy communities. The results evidence the advantages that electric vehicles may bring to communities if they are optimally exploited, highlighting their capability to enhance the efficiency and economy of the system.

Index Terms- Electric vehicle; Intelligent parking lot; Energy community; Energy storage

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