

An Innovative Two-Level Model for Electric Vehicle Parking Lots in Distribution Systems with Renewable Energy

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With the rapid growth of Electric Vehicles (EVs) in distribution systems, a new player, called EV parking lot operator (EV PLO), is emerging around the world. Furthermore, the integration of distributed generation in the distribution level, in particular, renewable energy sources (RESs), is leading to the establishment of various markets in distribution systems. On one hand, such PLOs aim at managing their EVs within their parking lots to participate in the distribution markets and to maximize their profits. On the other hand, a distribution system operator (DSO) seeks to minimize the system-wide cost while minimizing renewable power spillage and the side-effects of its intermittency. This interaction inspires the innovative two-level model proposed in this paper. In the first level, a new model is proposed for EV PLOs which models the EVs' characteristics, including EV owners' uncertainties, in a reasonably accurate manner. These PLOs are allowed to participate in energy, reserve and regulation distribution markets by optimally managing their EVs. In the second level, a new model is developed to ensure that the technical constraints in the distribution networks are met while minimizing the overall system cost. In addition, this work evaluates the effects of the penetration level and the placement of wind and solar PV on the offering strategies of EV parking lots, as well as on the overall performance of the distribution systems.