Market Design and Strategy Making for Proactive Distribution Grid with DERs - DTU Orbit (09/11/2017)

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Distributed energy resources (DERs) tend to occupy a high share in the distribution-level network. In a deregulated environment, this stimulates the distribution company (DISCO) to preferentially procure DERs' generations at comparable prices. In the U.S., the recent initiative named the New York Reforming Energy Vision (NY REV) has addressed the regulatory changes to liberate a distribution-level market for cost-eective use of DERs. To this end, the DISCO gets an opportunity to strategically engage in the transmission-level markets by rationally purchasing electricity from the distribution-level DERs. In this situation, the market framework becomes more complex. To handle these small-size and dispersed DERs, this thesis proposes a methodology to optimize the procurements of the proactive distribution company (PDI-SCO) trading in the presented distribution-level market. Particularly, takingthe demand response (DR) resource to represent a type of DERs, the PDISCO's procurement strategies can cover real-time market transactions and aggregatorbased DR. On the other hand, to maximize prot, the PDISCO is also eager to participate in the transmission-level markets. To achieve this goal, the PDISCO has to make decisions on procuring DERs' portfolios in distribution-level market, and strategically submits oers/bids to the transmission-level markets, simultaneously. Crossing the day-ahead and real-time markets, the transactions between PDISCO and markets are characterized in a bidirectional fashion. In order to capture the PDISCO's trading strategies mentioned above, the PDISCO trading within markets can be formulated as one-leader multi-follower game models, realizing in diering bi-level structures. Pertaining to the solving algorithm, the primal-dual approach is applied to reformulate each proposed bi-level model to a solvable single-level mathematical program with equilibrium constraints (MPEC). The eectiveness of the proposed models are veried by individual numerical analyses.

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