Incentives for electrical vehicle integration in electrical distribution systems

Abstract: The use of electric vehicles (EVs) is increasing to address emerging concerns about global warming associated with emissions from fossil fuels. Besides, in the context of parcel delivery related to e-commerce, EVs are becoming an alternative to conventional fossil fuel technology. The EVs charging process implies the interdependence between the transportation and electric power systems. To address these issues, we present a multistage optimization-based approach that allows linking delivery routing and aggregated demand management in the transportation and electric power systems, respectively. An EV demand aggregator is used to guarantee the synergy between systems. Incentives are included to motivate electric vehicles to remain at charging intersections. However, attractive incentives can create electric power system congestion due to simultaneous charges on nodes. Thus, an iterative decongestion methodology is developed. The resulting model is divided into three stages: delivery allocation, delivery routing for each independent EV, and optimal energy management by the EV demand aggregator. Numerical results demonstrate the effectiveness of the proposed model on a real 284-intersection map with a set of 100 electric vehicles, showing that incentives allow electric vehicle demand aggregator to achieve cost savings of 8.5%.