Charge scheduling for electric freight vehicles

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Electric freight vehicles (EFVs) are fast becoming a viable alternative for short- and mid-haul goods distribution. Most recent studies have dealt with the routing issues associated with EFVs, especially those stemming from their limited range, and have proposed models and algorithms for the optimization of routes that incorporate en route recharging. The issue of depot charge scheduling has received less attention than the routing component, but it nevertheless raises interesting challenges whose solution could facilitate the integration of EFVs in goods distribution schemes. In an urban environment, EFVs are often charged at a central depot and rarely use public charging stations during delivery routes. Therefore, the charging schedule at the depot must be planned ahead of time so as to allow the vehicles to complete their routes at minimal cost. Vehicle fleet operators are subject to commercial electricity rate plans, which should be accounted for in order to provide an accurate estimation of the energy-related costs and restrictions. In addition, high vehicle utilization rates can accelerate battery aging, thereby requiring degradation mitigation considerations. In this talk, we introduce and discuss a comprehensive and practical mathematical model for depot charge scheduling that integrates several useful considerations. We consider time-dependent energy costs, grid restrictions, a realistic charging process, and facilities-related demand (FRD) charges. We also provide tractable methods for integrating battery degradation considerations, and we draw several managerial insights through our numerical experiments.

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