Strategic planning of electric logistics fleets: A robust location-routing approach

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Abstract

The main source for noxious emissions and noise as well as 20% of European greenhouse gas emissions are caused by transportation activities. Electric commercial vehicles (ECVs) can contribute significantly to reduce these negative effects of transportation. However, for mid-haul transportation, recharging options en-route have to be considered while designing electric logistics fleet networks in order to keep ECVs competitive to internal combustion engine vehicles and thus, attractive for practitioners. Against this background, we present the robust electric location routing problem with time windows and partial recharging considering uncertainties in customer demand, time windows and customer locations. We discuss an adjustable robust counterpart (ARC), focusing on a non-adjustable component (siting charging stations) and an adjustable component (routing of ECVs). Since robust reformulation techniques are not sufficient to solve large sized instances, we present a hybrid of (parallelized) adaptive large neighborhood search and dynamic programming elements to solve large-sized instances by an adversarial approach. We derive new benchmark instances incorporating different degrees of uncertainty in underlying customer patterns. Results show the benefit of a robust modeling approach against different deterministic modeling approaches that aggregate the customer pattern uncertainty (partially) within the instance derivation.

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