

**Titles:** EVRPs under Hours of Service Regulations: The Impact of Synchronizing Driver Breaks and Charging Operations

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**Abstract:**

To meet global sustainability goals, companies are exploring greener and more efficient transportation solutions like the use of electric vehicles (EVs). However, the adoption of EVs introduces new challenges to vehicle routing problems (VRPs), primarily due to limited driving ranges, long charging times, and inadequate charging infrastructure. These constraints may hinder the competitiveness of EVs compared to internal combustion engine vehicles (ICEVs), particularly in mid- and long-haul contexts.

VRPs focus on determining the most optimal routes to service customers while considering various factors such as vehicle capacity, customer time windows, and the use of heterogeneous fleets. Another important factor that can influence optimal routing decisions is the consideration of mandatory driver breaks and Hours of Service (HoS) regulations, which require adhering to specific driving and rest periods to ensure safety. While these rules add constraints to routing decisions, they also present an opportunity to align mandatory rest periods with charging schedules, potentially enhancing the efficiency and competitiveness of EVs.

This study analyses the impact of synchronizing driver rest breaks with EV charging operations in mid- and long-haul transportation on the competitiveness of EVs. To achieve this, the Electric Vehicle Routing Problem with Truck Driver Scheduling (EVRP-TDS) is introduced, and an adaptive large neighborhood search algorithm is proposed to solve the problem. The analysis begins by comparing ICEV and EV models without HoS regulations. It then evaluates how incorporating HoS regulations affects the competitiveness of EVs. The findings provide valuable insights into optimizing EV logistics and demonstrate how accounting for regulatory requirements in operational planning can reduce the cost gap between EVs and ICEVs, making EVs a more viable option for long-distance delivery operations.