Combining NHTS Travel and Electric Load Data to Evaluate Plug-In Electric Vehicle Charging Impacts

Jonathan Dowds (corresponding author)
University of Vermont
Transportation Research Center
210 Colchester Ave.
Burlington, VT 05401
Phone: (802) 656-1433
Email: jdowds@uvm.edu

Paul Hines
University of Vermont
School of Engineering
210 Colchester Ave.
Burlington, VT 05401
Phone: (802) 656-9660
Email: paul.hines@uvm.edu

Growing electricity demand for plug-in electric vehicle (PEV) charging has the potential to impact all aspects of the electric power system from the lifespan of distribution transformers through power plant dispatch decisions and electricity prices. The magnitude of these impacts depends crucially on the timing of vehicle charging. While many early studies on the impact of PEVs assumed simplistic, evening and nighttime charging scenarios, it is likely that many PEV drivers will charge their vehicles whenever the PEV is at home and the battery is low. Using NHTS trip data, including trip time, trip length, trip destination, and vehicle type, the authors derived time-varying PEV charging profiles that were consistent with observed travel patterns. Charging demand (the energy required to charge a vehicle) was derived based on trip length, vehicle type, and PEV performance characteristics. Charging start times and durations were determined based on the time that travelers returned to and left from home and the charging demand. Charging profiles were created separately for weekends and weekdays. These individual, NHTS-derived PEV charging profiles were combined with publicly available household level load data from the Energy Information Administration's National Energy Modeling System to study the impact of PEV charging on transformer aging and in aggregate with regional load data from several Independent System Operators to study on the impact of PEV charging on the generating portfolio, overall generating fuel mix, and the costs of electricity generation.