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# Electrification of British Columbia's transportation sector – system impacts of alternative charging strategies

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ABSTRACT

Electrification is among the most effective strategies to decrease greenhouse gas emissions from road transportation. However, as more vehicles shift away from conventional drivetrains, demands on the electricity system must, necessarily, increase. In this study, the charging profile for a fully electrified transportation sector is modeled using a bottom-up approach for each vehicle class. A regionally-specific electricity system model, for the month of January, is then used to examine infrastructure and operational requirements, system costs, and greenhouse gas emission reduction potential for decarbonization through electrifying transportation.

Electricity demand associated with electrification of passenger vehicles has been investigated using household surveys and vehicle drive-cycle data taking a bottom-up approach. Commercial vehicles, however, have not been investigated to this same level of detail, largely due to a lack of data when compared to passenger vehicles.

In the current study, passenger vehicle demand profiles are generated with the U.S. Department of Energy's *Electric Vehicle Infrastructure Projection Lite Tool*. Synthetic demand profiles for light, medium and heavy-duty commercial vehicles are developed using the National Renewable Energy Lab's (NREL) *FleetDNA* dataset along with the *Heavy-Duty Electric Vehicle Depot Charging Tool,* also developed by NREL.

Based on these charging profiles, three transportation charging scenarios are modeled for passenger, light-, medium-, and heavy-duty vehicles. In the Immediate Scenario, each commercial vehicle is charged at 75 kW as soon as it is off shift until the battery is full. In the Delayed Scenario, each vehicle is charged at 75 kW until its next departure but the start of charging is delayed such that the battery is full at the moment of departure. In the Minimum Scenario, each vehicle is charged for the entire off-shift period at a rate that ensures that that the battery if full at the start of the next shift.

Each charging scenario is used to create a provincial electricity demand profile that includes transportation demand. This profile is used in SILVER, a spatially resolved production cost model, to investigate the feasibility and dispatch behaviour of a 100% renewable electricity system that powers all road transportation.

Preliminary results show that, in the Minimum and Immediate Scenarios, a 100% renewable grid cannot meet demand. To enable feasible solutions, therefore, natural gas generation is made available. In the Minimum and Immediate Scenarios, respectively, natural gas generation meets 8% and 7% of total electricity demand. This is caused by differences in profiles for demand and renewable generation capacity.

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