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National Center for Sustainable Transportation

POLICY BRIEF

Developing Markets for Clean Heavy-Duty Trucks in Short-Haul Applications

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A zero- or near-zero-emission vehicle fleet is key to achieving California's greenhouse gas and air pollution reduction goals. While substantial progress has been made with passenger vehicles, use of zero-emission, heavy-duty trucks for freight movement remains a challenge. Battery-electric trucks are commercially available but battery technology is not yet competitive with the traditional diesel engine for hauling heavy loads. California is pursuing multiple policies to spur the transition to a cleaner heavy-duty vehicle fleet, including the Advanced Clean Trucks rule requiring 40% of truck tractor sales in 2035 to be zero emission, the in-progress Advanced Clean Fleets rulemaking to mandate the purchase of zero-emission trucks by fleets, and an executive order requiring 100% of all drayage trucks to be zero emission by 2035. Drayage trucks pick up and deliver goods to and from ports, warehouse and distribution centers, and intermodal facilities.

Achieving these targets will require massive change in the heavy-duty short-haul industry, and many unanswered questions remain. How do battery-electric heavy-duty trucks compare to diesel in everyday short-haul operations? How much would it cost to transition to a zero-emission truck fleet, and who would pay?

To begin to answer these questions, researchers at the National Center for Sustainable Transportation conducted a comprehensive analysis of the potential for zero-emission or near-zero-emission heavy-duty trucks to be used in short-haul drayage services. The researchers considered operational, economic, and environmental impacts through simulation modeling, interviews, case studies, stated preference surveys, and cost-effectiveness analyses.

Key Research Findings

Presently, battery-electric heavy-duty trucks are not a practical substitute for diesel drayage trucks. While they would achieve the greatest overall greenhouse gas reductions of any technology, the limited range and required charging time of current battery-electric trucks would significantly impact freight operations. Simulation results using optimistic assumptions show that operators introducing significant numbers of battery-electric trucks into their fleets would still need to retain diesel trucks and operate a greater total number of vehicles to accommodate all their trips. More vehicles add to total costs, generating a high price per ton of emissions reduced.

The medium-term battery-electric truck market is promising and depends critically on the rate of technology improvement and decline in vehicle price. Battery-electric heavy-duty truck market potential is projected to be much greater in 2025 and 2030 due to assumed battery technology improvements and vehicle price reductions. These assumptions are based on the best available projections. Greatly expanding the battery-electric truck market will require even more ambitious technology improvement or large public subsidies, emphasizing the importance of continuing to promote and invest in battery technology improvements.

Natural gas hybrid near-zero-emission vehicles would provide a more cost-effective means of emissions reductions in the short term. Natural gas hybrid-electric trucks have a comparable range and weight to conventional diesel, and hence do not impact freight operations. Their capital costs are also lower than battery-electric trucks. Simulation scenarios show that natural gas hybrid fleets could achieve reductions in criteria pollutants and greenhouse gases at a net cost savings out to 2030 (Figure 1), although the quantity of reductions would be less than that achieved by battery-electric fleets.

The medium-term market for battery-electric heavy-duty trucks depends on public subsidies. While the capital cost differential for battery-electric trucks is expected to shrink considerably between now and 2030, the range, load capacity, and charging constraints will be slower to disappear. Charging station construction costs present another adoption barrier, especially if firms are expected to build their own charging stations. Surveys and interviews also revealed a general distrust of the technology. If the state targets are to be met, subsidies to overcome these barriers will be required.

Policy Implications

Given the current advantages of natural gas hybrid technology, state and local policies should be flexible enough to consider hybrid technologies as a viable short- and medium-term option for emissions reductions. Policies that focus exclusively on battery-electric trucks are likely to result in small near-term emissions reductions and may also crowd out research on fuel cells or other potentially more effective technologies.

To encourage longer-term adoption of battery-electric heavy-duty trucks, incentives need to be customized and marketed for diverse trucking firms. A one-stop website providing information for fleet operators on available subsidies and how to apply for and receive them could encourage adoption. State and local governments should also consider incentives that go beyond those designed to reduce capital costs such as fee waivers, discounted electricity rates, and priority access to port terminals.

More Information

This policy brief is drawn from “Developing Markets for Zero-Emission Vehicles in Short-Haul Goods Movement,” a report from the National Center for Sustainable Transportation, authored by Genevieve Giuliano, Maged Dessouky, Sue Dexter, Jiawen Fang, and Shichun Hu of the University of Southern California; Seiji Steimetz and Thomas O’Brien, of California State University, Long Beach; and Marshall Miller and Lewis Fulton of the University of California, Davis. The full report can be found on the NCST website at https://ncst.ucdavis.edu/project/developing-markets-zero-emission-vehicles-zevs-goods-movement.

For more information about the findings presented in this brief, contact Genevieve Giuliano at giuliano@price.usc.edu.

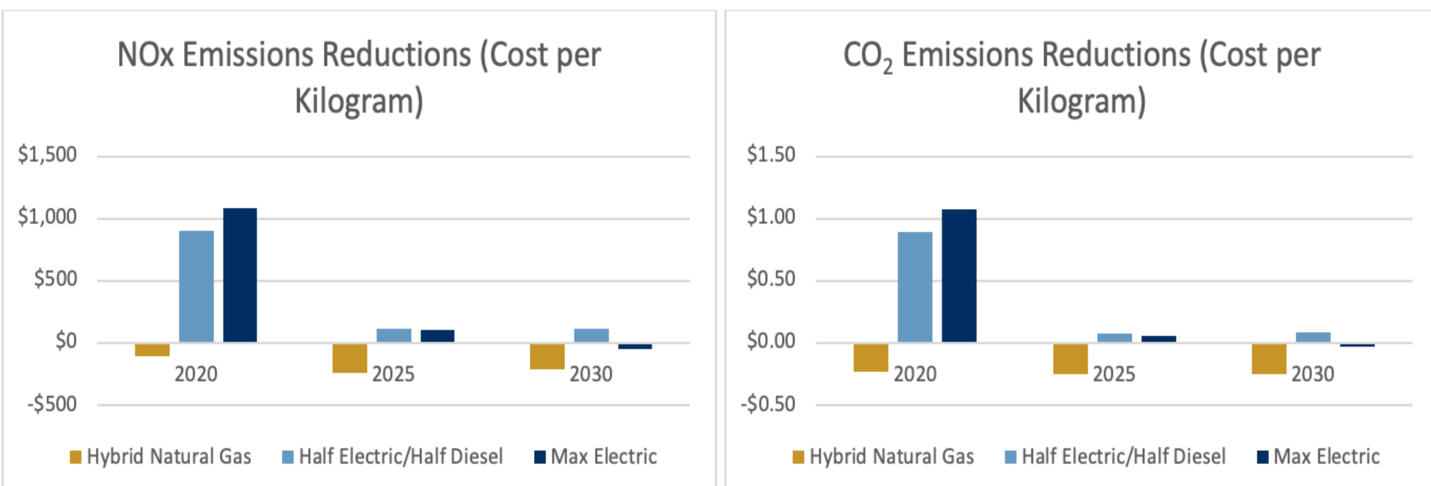

Figure 1. Modeled cost of nitrogen oxide (NOx) and carbon-dioxide (CO_2) emissions reductions in a simulated drayage truck fleet under hybrid natural gas, half battery-electric/half diesel, and almost entirely battery-electric fleet scenarios compared to an all-diesel fleet. The baseline, an all-diesel fleet, is $0. Negative values represent cost savings compared to an all-diesel fleet.

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