National Center for Sustainable Transportation

POLICY BRIEF

The Costs of Owning Battery-Electric Trucks – Is the Research Aligning?

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Issue

California and other states are pursuing strategies to transition to zero-emission passenger vehicles and trucks, and regulations under development in California will shape multiple states' transition to zero-emission medium- and heavy-duty trucks. A key factor influencing the pace of these regulations and complementary incentive programs is when battery-electric trucks can be expected to reach cost parity with conventional diesel trucks. Since few battery-electric truck models are available, an engineering technology cost analysis is typically used to estimate future purchase cost and "total cost of ownership" for near-term and longer-term (e.g., 2030) comparisons with diesel trucks.

Over the past four years, several agencies, think tanks, and researchers have published studies on likely purchase cost and total cost of ownership of battery-electric trucks. These studies have produced different estimates about these trucks' current and future competitiveness with diesel trucks. Comparing these studies, their assumptions, and their total cost of ownership estimates can help policymakers understand the differences between these technologies and allow for more accurate total cost of ownership estimates to be developed in the future. Such comparisons can ultimately help policymakers understand the financial impacts fleets will experience in transitioning to zero-emission vehicles, and the likelihood of fleets purchasing zero-emission vehicles independent of regulatory requirements.

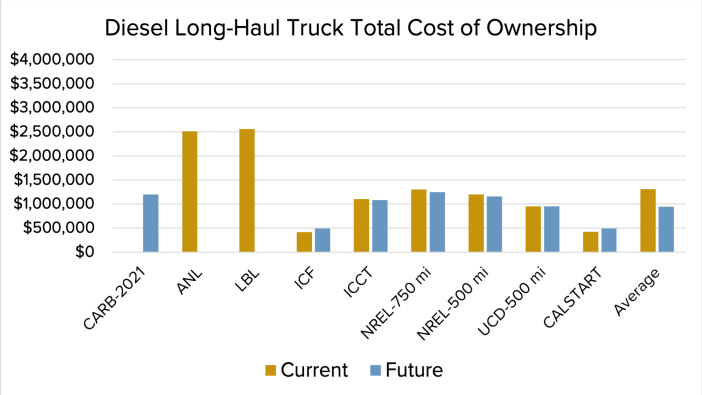
Researchers at the University of California, Davis reviewed 10 recent studies of the total cost of ownership of battery-electric trucks, now and in the future, compared to a baseline diesel truck. The researchers examined a range of important cost and operating factors, such as vehicle purchase cost, efficiency, fuel cost, maintenance cost, required range and thus battery pack sizing, and other factors. They noted differences in the studies' major assumptions and in variables that are included or excluded from consideration. The researchers did not judge these studies against each other but attempted to derive general findings that are robust across all the studies. They also sought to identify areas of significant difference and areas for further research.

Key Research Findings

While there is a wide range in estimates across studies for specific types of trucks in specific years, all the studies expect the total cost of ownership for battery-electric trucks to reach cost parity with diesel trucks between 2025 and 2035 (Figure 1). The specific timeframe varied considerably depending on the study and the type of truck considered (heavy-duty long-haul trucks, medium-duty delivery trucks, and heavy-duty drayage/short-haul trucks).

The most important factors affecting total cost of ownership and the relative cost of battery-electric trucks vs. diesel trucks include vehicle prices, fuel prices, vehicle efficiency, and miles driven. Some factors affecting total cost of ownership, such as diesel truck fuel economy, appear to have broad agreement across studies. Others, such as fuel prices, show a wide variation.

A handful of key differences in assumptions account for much of the variation in the studies' estimates and conclusions. The



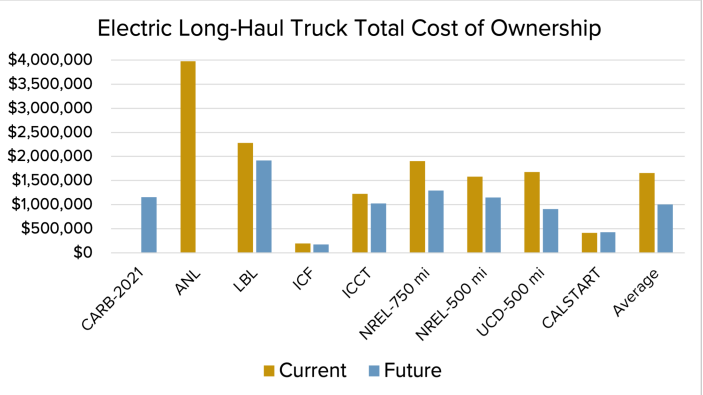


Figure 1. Total cost of ownership estimates of conventional diesel and electric long-haul trucks from the studies—conducted by the California Air Resources Board (CARB), Argonne National Laboratory (ANL), Lawrence Berkeley National Laboratory (LBL), ICF, the International Council on Clean Transportation (ICCT), the National Renewable Energy Laboratory (NREL), UC Davis (UCD), and CALSTART—reviewed by the research team.

studies showed significant differences in assumed fuel economy and maintenance costs for battery-electric trucks vs. diesel trucks, battery-electric trucks' future efficiency and range, and the current and future prices of both diesel and electricity. Some of this variation is unavoidable, since there really is wide uncertainty about the future. However, there may be opportunities to narrow the range of some projections through discussion and cooperation on future research.

Few studies have explicitly considered non-cost factors in their analyses of battery-electric trucks. Factors such as charging time and impacts to payload due to the extra weight of the battery system do not typically directly affect total cost of ownership calculations but could have strong effects on fleet managers' vehicle purchase choices.

The costs associated with charging infrastructure are not clearly elaborated in most studies or are difficult to identify. Some studies appear to ignore these costs, while some amortize them and include them in either the retail price of electricity or the cost of the vehicle.

Few studies account for current policies or the possibility of future policy changes that could make battery-electric trucks cost competitive at an earlier date. The role of policies, particularly the credit system under California's Low Carbon Fuel Standard, appear very important in determining total costs of ownership and the relative total costs of ownership between battery-electric and diesel trucks.

Future studies should base their analyses on the specific attributes of trucks being offered for sale as more models come onto the market. However, longer-term estimates will need to project underlying vehicle attributes and factors as outlined above. Using sensitivity analysis and referring to comparisons like this research to show where cost estimates fall within a general range will provide helpful context for these longer-term estimates.

More Information

This policy brief is drawn from "The Current and Future Performance and Costs of Battery Electric Trucks: Review of Key Studies and a Detailed Comparison of Their Cost Modeling Scope and Coverage," a report from the National Center for Sustainable Transportation, authored by Guihua Wang, Lew Fulton, and Marshall Miller of the University of California, Davis. The full report can be found on the NCST website at https://ncst.ucdavis.edu/project/current-and-future-performance-and-costs-battery-electric-trucks.

For more information about the findings presented in this brief, contact Lew Fulton at lmfulton@ucdavis.edu.

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