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Heavier Alternative Fuel Trucks Are Not Expected to Cause Significant Additional Pavement Damage

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Issue

Medium- and heavy-duty trucks on California's roads are shifting from conventional gasoline and diesel propulsion systems to alternative fuel (natural gas, electric, and fuel cell) propulsion technologies, spurred by the state's greenhouse gas (GHG) reduction goals. While these alternative fuel trucks produce fewer emissions, they are also currently heavier than their conventional counterparts. Heavier loads can cause more damage to pavements and bridges, triggering concerns that clean truck technologies could actually increase GHG emissions by necessitating either construction of stronger pavements or more maintenance to keep pavements functional. California Assembly Bill 2061 (2018) allows a 2,000-pound gross vehicle weight limit increase for near-zero-emission vehicles and zero-emission vehicles to enable these trucks to carry the same loads as their conventional counterparts. The law also asked the UC Institute of Transportation Studies to evaluate the new law's implications for GHG emissions and transportation infrastructure damage.

To conduct this analysis, researchers at UC Davis considered three adoption scenarios of alternative fuel trucks in two timeframes, 2030 and 2050 (Figure 1). Based on these scenarios, the researchers used life cycle assessment and life cycle cost analysis to evaluate how heavier trucks might affect pavement and bridge deterioration, GHG emissions, and state and local government pavement costs. The study did not evaluate the safety implications of increasing allowable gross vehicle weights.

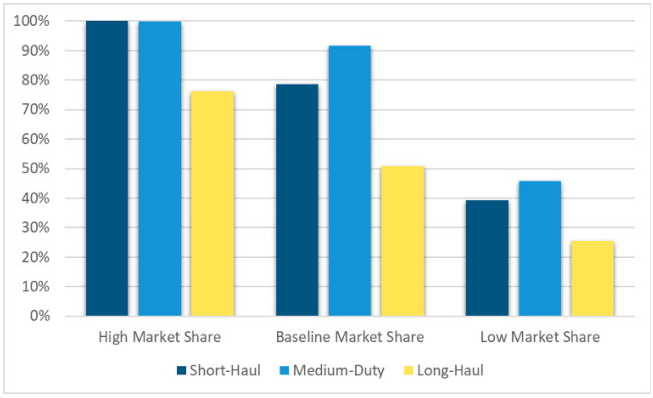

Figure 1. Three scenarios for alternative fuel truck market penetration developed for the study. Percentages represent the percent fleet share achieved by each truck type in 2050.

Key Research Findings

Introducing heavier alternative fuel trucks, as allowed by AB 2061, is expected to result in only minimal additional damage to local and state government-owned pavements. Electric and fuel cell truck technologies are expected to remain heavier than conventional trucks until around 2030, but relatively few of these vehicles are expected on California's roadways during this period. Adoption is anticipated to increase rapidly after 2030, by which time the weight of these vehicles should decrease as the technologies improve. Simulations of these concurrent trends—decreasing weight and increasing market penetration—result in limited pavement damage. Pavement damage is also expected to be limited because it is mainly driven by heavy axle loads rather than gross vehicle weights, and AB 2061 does not change axle weight limits.

Furthermore, short-haul and medium-duty trucks—i.e., those most likely to incorporate the heavier alternative fuel systems before 2030—tend to operate well below current axle load limits, leaving them a margin for the additional weight. This also means that higher gross vehicle weight limits will probably not spur short-haul and medium-duty truckers to increase their payloads when the technologies become lighter after 2030.

Although natural gas vehicle technology cannot become lighter, it is not expected to have significant market penetration. Where natural gas vehicles may replace a large proportion of diesel vehicles, such as on waste facility access roads, pavement damage could increase somewhat. The additional damage could be accommodated by increasing the structural capacity of those specific roads, at a cost increase of not more than about 20%.

The cost of additional pavement damage from alternative fuel trucks will be negligible. The estimated annual cost increase for pavement damage is between zero and $21 million for the state highway network, and between zero and $33 million for the local roads network. These costs represent small percentages of the billions of dollars spent annually on state and local government pavement maintenance and rehabilitation. Improved pavement construction quality, design, management, and materials over the next 10 to 30 years should easily compensate for the expected small cost increases.

Projected GHG emissions reductions from alternative fuel truck adoption will far outweigh emissions from additional road maintenance. While the small increase in road damage caused by alternative fuel trucks would lead to some additional emissions attributable to increased maintenance and rehabilitation, the emissions reductions from transitioning the truck fleet to lower- or zero-emission vehicles are estimated to be 70 to 900 times greater by 2050, depending on the percentage of alternative fuel trucks on the road. The study did not evaluate the extent to which increased road roughness could contribute GHG emissions because the effects were considered small compared to those of other factors, and because there is no information available regarding the effects of roughness on alternative fuel trucks.

The ability to model the effects of heavier alternative fuel trucks on bridges is very limited. The US Department of Transportation recommends not raising weight limits on bridges until impacts can be better understood. While allowing weight increases of up to 2,000 pounds is unlikely to cause major issues on more modern bridges, the effects of concentrations of heavier trucks on bridges that are already inadequate, and which are mostly owned by local governments, should be evaluated more carefully on a case-by-case basis.

Policy Considerations

As California transitions to alternative fuel trucks, monitoring changes in pavement and bridge damage will be important. Refining the results of the current research will require improvements in: data collection and models for implementation of alternative fuel trucks, alternative fuel vehicle axle and vehicle weight changes, GHG emissions related to truck manufacture and use, the effects of road roughness on alternative fuel truck energy use, and bridge deterioration.

More Information

This policy brief is drawn from the report "Effects of Increased Weights of Alternative Fuel Trucks on Pavement and Bridges" prepared by John Harvey, Arash Saboori, Marshall Miller, Changmo Kim, Miguel Jaller, Jon Lea, Alissa Kendall, and Ashkan Saboori of the University of California, Davis. The report and a digital copy of this brief can be found at: www.ucits.org/research-project/2020-19. For more information about findings presented in this brief, please contact John Harvey at jtharvey@ucdavis.edu.

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