Institute of Transportation Studies
UNIVERSITY OF CALIFORNIA

Transitioning to Electric Drayage Trucks May Help Avoid Adding New Freeway Lanes to Freight Corridors in Southern California

Monica Ramirez Ibarra, Ph.D., and Jean-Daniel Saphores, Ph.D.
Department of Civil and Environmental Engineering, University of California, Irvine

August 2024

Issue

Much has been written about the potential benefits of electric and connected vehicles. However, one important, but often overlooked, implication of electrifying trucks is that if they are powerful enough (such as the Tesla semi), they can eliminate the moving bottleneck[1] or queuing effect created by slow-moving conventional heavy-duty trucks because electric trucks are much more responsive compared to conventional diesel trucks because electric motors provide maximum torque from a standstill. This could substantially increase road capacity in areas with high commercial truck traffic, especially around major ports or logistics complexes, thus alleviating the need to add new lanes to local freeways.

To better understand these benefits, we quantified the potential speed improvements and road infrastructure implications from replacing conventional drayage trucks with electric and/or connected heavy-duty trucks around the largest port complex in North America, and explored the implications for road infrastructure financing in the U.S. We believe our study is the first to conduct a detailed analysis of how electric and connected trucks could affect traffic conditions and roadway demand in an expanded freight corridor, specifically, the I-710 corridor (the nation's busiest freight corridor) that connects the Ports of Los Angeles and Long Beach in Southern California, which are projected to handle 145 percent more cargo by 2035, with railyards and other major freeways south of downtown Los Angeles. I-710 plays a critical role in moving goods to and from the ports and could be heavily impacted by the anticipated growth of the port complex. Our study area also includes the I-110 corridor (an alternative to I-710) and some arterials that carry a large number of heavy-duty trucks.

Key Research Findings

Without additional road capacity or major changes in vehicle technology, average road speeds of major freight corridors in Southern California could drop dramatically by 2035. Because of the large projected increase in freight traffic, average road network speeds in Southern California could drop from 37.8 mph to 33.3 mph by our estimates, and the average speeds of heavy-duty drayage trucks could sink to 18.5 mph compared to 51.5 mph in 2012, a decline of 64 percent.

Based on cargo growth projections for 2035, adding a lane to I-710 and improving selected ramps would not be enough to restore drayage truck speeds to 2012 levels. Adding a general-purpose lane (i.e., a lane for all vehicles; both passenger and trucks) along I-710 and improving selected I-710 ramps would increase overall freeway speeds marginally to 38.4 mph (compared to the 37.8 mph average for 2012), but the average speed of drayage trucks would only reach 45.1 mph, well below the 2012 value of 51.5 mph. These results imply that adding a lane to I-710 would be required merely to accommodate projected growth in port activity.

Improving some ramps on I-710 and replacing diesel drayage trucks with electric trucks (with a similar horse power) could accommodate 2035 cargo growth projections. Replacing sluggish diesel port trucks with more responsive and powerful 1,000-horsepower electric trucks would substantially improve average freeway speeds. Combined with ramp improvements, it would be enough to improve average speeds for both light-duty vehicles and drayage trucks above 2012 levels and could substitute for politically controversial road infrastructure investments like adding freeway lanes.

Equipping drayage trucks with Cooperative Adaptive Cruise Control only has a small impact on speeds. Equipping heavy-duty drayage trucks (diesel or electric) with Cooperative Adaptive Cruise Control that uses connected vehicle technology to automatically adjust each truck's speed to match the speed of vehicles in front of it to minimize queuing, would increase speeds by only a few mph, though it could improve road safety.

New vehicle technologies may make road expansion unnecessary in some cases. Vehicle electrification coupled with increased connectivity and automation could greatly improve vehicle operation and performance to the extent that road expansion (in some cases) may not be needed. In turn, policymakers should carefully consider the performance of new vehicle technologies when determining future road infrastructure improvements and expansions. And given the potential cost savings associated with avoided road expansion, policymakers may want to consider how to further expedite adoption of these vehicles, such as providing purchase incentives for smaller truck operators and banning heavy-duty diesel vehicles along specific freight corridors.

More Information

This policy brief is based on the paper "1,000 HP Electric Drayage Trucks as a Substitute For New Freeway Lanes Construction"[2] available at www.ucits.org/research-project/2020-53. For more information about the findings presented in this brief, please contact Jean-Daniel Saphores at saphores@uci.edu.

[1]Newell, G.F. A moving bottleneck. Transportation Research Part B: Methodological 32, 531–537, 1998. https://doi.org/10.1016/S0191-2615(98)00007-1

[2]Ramirez-Ibarra, M., and Saphores, J. D. "1,000 HP electric drayage trucks as a substitute for new freeway lanes construction." Transportation Research Part A: Policy and Practice, 171, 103646, 2023. https://doi.org/10.1016/j.tra.2023.103646

Research presented in this policy brief was made possible through funding received by the University of California Institute of Transportation Studies (UC ITS) from the State of California through the Public Transportation Account and the Road Repair and Accountability Act of 2017 (Senate Bill 1). The UC ITS is a network of faculty, research and administrative staff, and students dedicated to advancing the state of the art in transportation engineering, planning, and policy for the people of California. Established by the Legislature in 1947, the UC ITS has branches at UC Berkeley, UC Davis, UC Irvine, and UCLA.

Project ID UC-ITS-2020-53 | DOI: 10.7922/G2F769WD