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Authors
Fulton, Lewis
Lipman, Timothy
Coffee, Daniel

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Expanding Hydrogen Use Across Transportation Modes in California Could Cut Emissions and Create Jobs

Lewis Fulton, University of California, Davis, Timothy Lipman, University of California, Berkeley, and Daniel Coffee, University of California, Los Angeles

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Issue

California is investing in a hydrogen system as part of its strategy to reduce greenhouse gas emissions from transportation and industry. While much of the state's hydrogen planning has focused on demand from cars and trucks, other transportation sectors—including ports, aviation, and rail—could provide significant demand. At the same time, uncertainty surrounding federal support, including the suspension of $1.2 billion in federal funding for the ARCHES hydrogen hub,[1] has raised new questions about how California should prioritize and coordinate future hydrogen investments to best support decarbonization and public health goals.

There has been limited analysis of how demand could develop across multiple transportation modes and where hydrogen production and refueling infrastructure should be located to maximize efficiency and reduce costs. The potential environmental and workforce impacts of a statewide hydrogen system are also not well understood.

To address these gaps, we modeled hydrogen use through 2030 and 2045, across multiple transportation modes in California—trucks, transit buses, seaport and airport ground vehicles, aircraft, trains, and light-duty vehicles. We developed two scenarios, with low vs. high levels of adoption of hydrogen-powered vehicles over time, for example reaching 10% vs. 30% market share of heavy-duty trucks by 2040. We used the scenarios to estimate a range of potential future hydrogen demand, greenhouse gas reductions, infrastructure needs, and job creation. This brief focuses on the high-adoption scenario, where benefits are much greater—but stronger policy support would be needed.

Key Research Findings

Heavy-duty trucking, if developed as planned, is projected to drive much of California's future hydrogen demand, but other transportation modes could represent nearly half of total demand by 2045. In our high-adoption scenario, trucks dominate, but significant demand also comes from light-duty vehicles, buses, trains, and aircraft, and less from port and airport ground vehicles. The scenario does not include the hydrogen use in ships or as a feedstock (rather than a direct fuel) to produce other fuels, such as methanol or ammonia.

Truck refueling stations could be anchors for a broader hydrogen fueling network. The planned production, delivery, and station infrastructure for trucks could meet early demands from other modes. Our estimates suggest that 10 to 20 well-located stations could serve most

truck refueling through 2030 while supporting additional transportation modes.

Hydrogen adoption across transportation modes could substantially reduce greenhouse gas emissions. Replacing diesel-powered vehicles with hydrogen-powered ones would cut 100% of pollutant emissions (e.g., particulate matter and nitrogen oxides) and could cut CO_2 emissions per vehicle by 50% or more. Reductions will be greater if hydrogen is produced from renewable electricity and biomass. The largest overall CO_2 reductions in the high-adoption scenario are expected in trucking, where as many as half of California's heavy-duty trucks could run on hydrogen by 2045. As mentioned, this scenario will depend on strong policies, such as support for development of a hydrogen supply system and stations to serve vehicles. As described in the report, the state continues to provide funding of this type.

Developing a statewide hydrogen system could generate thousands of jobs. We project about 6,000 new jobs related to station construction, hydrogen supply infrastructure development, and hydrogen production, with further growth likely in the broader supply chain.

Achieving high hydrogen adoption will require consistent policy and funding support. Our high-adoption scenario assumes continued state and federal investments through 2035. These should be well coordinated across the supply chain and come with demand-side industry investments into, for example, refueling facilities. Given the loss of federal funding for ARCHES, the state is considering alternative approaches such as targeted incentives. Identifying smaller, well-coordinated system steps toward a bigger system may be key. For example, a first effort toward 500 trucks rather than 5,000, by 2030, may be enough to get the system up and running and start to reduce costs. Using other mechanisms, such as special financing, bulk procurements should be considered. Finally, we recommend the state and stakeholders:

- Improve coordination across the hydrogen value chain by exploring approaches that encourage better alignment between fleets, stations, fuel suppliers, and vehicle manufacturers, and that they consider methods for distributing the financial risk across these players.
- Strengthen the link between demonstrations and market scale-up by ensuring demonstrations generate actionable lessons for broader deployment and create stronger processes for capturing and sharing lessons learned.

More Information

This policy brief is drawn from the report *Mapping the Potential of Hydrogen and Fuel Cell Electric Vehicles Across Transportation Sectors in California*. The report can be found on the project webpage here: www.ucits.org/research-project/2024-28-3z/. For more information, please contact Lewis Fulton at lmfulton@ucdavis.edu.

[1]The Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) is a statewide public-private partnership working to accelerate the development and deployment of industrial-scale clean hydrogen projects and infrastructure across California to support decarbonization, energy resilience, and economic development. More information can be found at https://archesh2.org.

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