National Center for Sustainable Transportation

POLICY BRIEF

Future Connected and Automated Vehicle Adoption Will Likely Increase Car Dependence and Reduce Transit Use without Policy Intervention

Giovanni Circella, Miguel Jaller, Ran Sun, Xiaodong Qian, and Farzad Alemi
University of California, Davis

April 2022

Issue

California sits at the epicenter of self-driving vehicle technology development, with numerous companies testing connected and automated vehicles (CAVs) in the state. CAVs have the potential to improve safety and increase mobility for children, the elderly, and people with disabilities. These vehicles will operate more efficiently, use less space on the roadway, and cause fewer crashes, all of which are expected to relieve traffic congestion. However, CAVs will also likely bring about complex changes to travel demand, urban design, and land use. CAVs will make car travel far easier, eliminating the burden of driving. This could shift travel from other modes, influence people's decisions about where to live and work, and, when combined with the ability to send CAVs on trips without a passenger, lead to much more car travel.

The degree to which these changes will affect vehicle miles traveled, energy use, and air pollution in California is unknown and could have wide-ranging implications for the state's ability to meet its climate goals. Researchers at the University of California, Davis investigated the range of potential impacts that rapid adoption of CAVs in California might have on vehicle miles traveled and emissions. The researchers designed six CAV deployment scenarios extending to 2050, each with an upper and lower bound. The upper bounds account for additional vehicle travel due to the reduced burden of driving (induced demand) and the ability to relocate CAVs without passengers (deadheading). The researchers estimated the vehicle miles traveled and emissions of each scenario using a statewide travel demand model, emissions factors from California agencies, and assumptions derived from the scientific literature and expert input.

Key Research Findings

The scenarios, particularly at their upper bounds, show that CAVs will likely increase car travel significantly. Rapid adoption of privately owned CAVs could increase vehicle miles traveled by 38% over the levels predicted if there were no automation, when considering additional travel from induced demand and deadheading (Figure 1). The increase in vehicle travel was marginally smaller in scenarios in which CAVs were deployed as part of shared ridehailing fleets rather than as privately-owned vehicles.

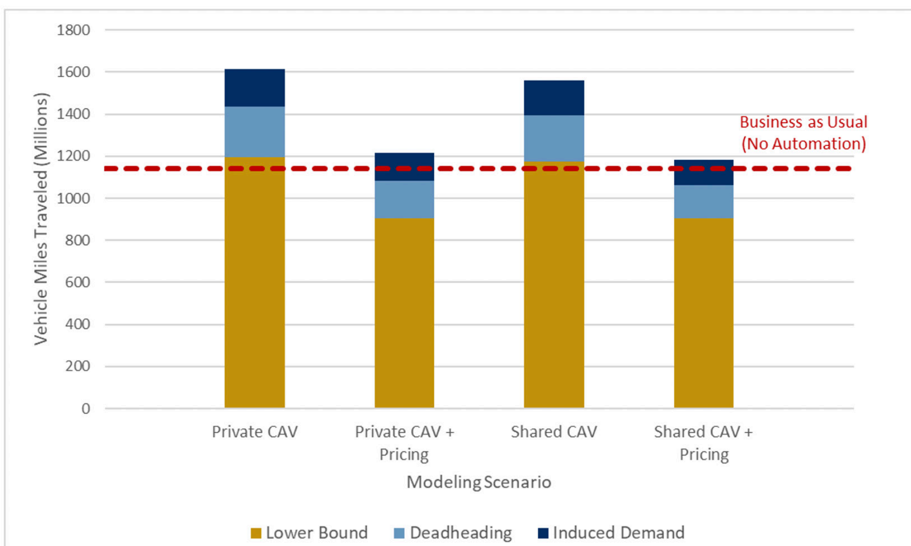

Figure 1. Estimated vehicle miles traveled across four scenarios using privately owned CAVs or shared CAVs, with or without pricing imposed for vehicle travel. The lower bound shows the model results without accounting for the additive effects of deadheading (empty CAV travel) and induced demand, which bring the VMT to a higher level (i.e., upper bound).

CAVs will cause substantial mode shift from public transit to automobiles. The mode share of short-distance transit, long-distance rail, and in-state air travel each decreased by at least 33% and often more than 60% in scenarios simulating privately owned or shared CAVs. These scenarios also showed a large drop in active travel, such as walking and bicycling.

Pricing and sharing can slow the growth of vehicle miles traveled. Scenarios that simulated a vehicle miles traveled tax or congestion fee, thereby increasing the cost of car travel, resulted in smaller increases, and in some cases reductions, in car trips and vehicle miles traveled compared to the baseline scenario without automation. A combination of pricing and deployment of shared CAVs reduced vehicle miles traveled still further. However, even these scenarios showed a significant reduction in public transit mode share.

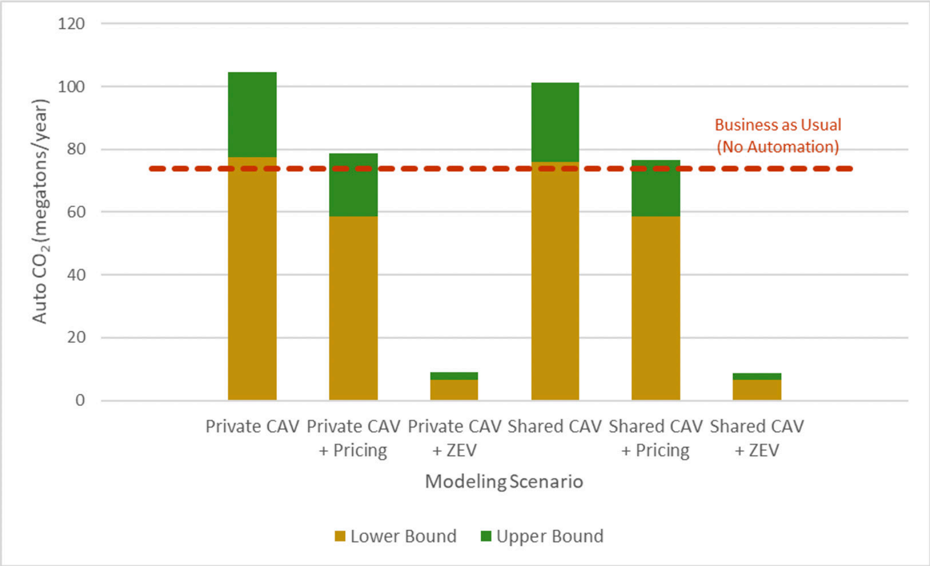

Figure 2. Estimated vehicle carbon dioxide (CO_2) emissions across six scenarios, including two scenarios with a high rate of zero-emission vehicle (ZEV) adoption.

A rapid transition to zero-emission vehicles will dramatically reduce emissions from CAVs. Most CAV deployment scenarios, as compared with the baseline with no automation, produced increases in local air pollutants and greenhouse gas emissions commensurate with increases in vehicle miles traveled. However, emissions were considerably lower, even with such increases in vehicle miles traveled, in scenarios that assumed a high rate of zero-emission vehicle adoption (Figure 2).

Policy Implications

While the modeling method used in this study has limitations, the evidence seems clear that CAVs will likely substantially increase car travel and emissions. The model may even underestimate some of these effects, as it does not account for potential land use changes brought about by CAV adoption (e.g., increased suburban sprawl if commuters live further from employment centers).

These results point to several key actions that could help minimize the negative impacts of CAVs. These include: developing programs that promote shared rather than privately owned CAVs and deploy CAVs to connect travelers to transit services; adopting a rapid timeline for vehicle electrification; implementing pricing policies that reflect the social costs of vehicle travel; coordinating land use development to combat the suburban sprawl that CAVs will likely precipitate; and rooting planning efforts in direct community engagement to ensure that historically underserved populations have a voice in how CAVs are introduced.

More Information

This policy brief is drawn from "Emissions Impact of Connected and Automated Vehicle Deployment in California," a report from the National Center for Sustainable Transportation, authored by Giovanni Circella, Miguel Jaller, Ran Sun, Xiaodong Qian, and Farzad Alemi of the University of California, Davis. The full report can be found on the NCST website at https://ncst.ucdavis.edu/project/emission-impacts-connected-and-automated-vehicle-deployment-california.

For more information about the findings presented in this brief, contact Giovanni Circella at gcircella@ucdavis.edu.

DOI: 10.7922/G2BZ64CX