Title
Travel Effects and Associated Greenhouse Gas Emissions of Automated Vehicles

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Travel Effects and Associated Greenhouse Gas Emissions of Automated Vehicles

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POLICY BRIEF

Issue

Automated vehicles (AVs) may significantly disrupt our transportation system, with potentially profound environmental effects. This policy brief outlines the mechanisms by which AVs may affect the environment through influencing travel demand, as well as the magnitude of these effects on vehicle miles travelled (VMT) and greenhouse gas (GHG) emissions. Personal AVs and AV taxis (or ride-hailing services) are likely to increase VMT and GHG emissions, exacerbate traffic congestion in city centers, and potentially lead to suburban sprawl. Electrification and vehicle sharing may reduce some of these environmental effects, but targeted policies must be put in place to ensure that these solutions are effective.

Experts predict that AVs could be available to the public by as early as 2025 or as late as 2035.[i] Research on AVs is extremely important, but difficult without the existence of large-scale pilot projects conducted on public roads. As a result, AV research is largely conducted by extrapolating effects from current observed behavior and drawing on theory and simulation models. This research project reviewed modeling studies to understand the potential effects of AVs on the environment. Researchers identify several interconnected mechanisms that could lead to environmental effects. These can be generally grouped into (1) improved safety and (2) altered travel behavior.

Improved Safety Mechanisms: Improved safety mechanisms within individual AVs and communication between AVs may affect road capacity, energy use, and the monetary cost of travel. Automation should lower the risk of collision, making smaller, lighter vehicles feasible, thus reducing the energy requirement and GHG emissions per vehicle. However, harmonization between AVs could also lead to shorter required 'headways' (distance between vehicles) and streamlined traffic flow, increasing road capacity and VMT. Reduced fuel use and lower insurance costs associated with AVs could also increase demand for vehicles.

Altered Travel Behavior Mechanisms: As auto travel becomes less expensive and passengers use time spent in vehicles for other purposes besides driving, they may choose to make more discretionary trips or live farther from their destinations. This 'induced travel' would increase total VMT. New travelers who formerly could not drive due to age, disability, or monetary constraints may also increase VMT. Automated vehicles themselves will have different travel behavior than their human drivers. AVs may significantly reduce parking demand in city centers as they drop off their passengers and relocate to home garages or to pick up other passengers. This relocation travel may account for a significant portion of AV travel, and may increase VMT and congestion in city centers.

This report reviewed scenario modeling studies, which commonly include fleets of personal AVs and AV taxis with and without sharing. Travel and/or land use models are used to simulate the cumulative effects of scenarios. These models typically use travel activity data and detailed transportation networks to replicate current and predict future land use, traffic behavior, and/or vehicle activity in a real or hypothetical city or region.

Key Research Findings

Automation could double or triple highway road capacity and exacerbate congestion. Increased road capacity is predicted to increase VMT by 3–6% for every 10% increase in road capacity in the short run, and 10% for every 10% increase in road capacity in the long run. Increased highway capacity is expected to exacerbate congestion issues in city centers.

Travel time and cost impacts vary. Studies that model the effects of gas prices on VMT show that for every 10% decrease in fuel costs, VMT may increase by 0.3–1% in the short run and 1.3–3% in the long run. Estimates of the reduced 'time cost' of travel vary, but AV passengers may reasonably see an 18–25% reduction in the 'travel burden' as they are able to pursue other activities during travel. Fleets of AV taxis are expected to decrease fares due to reduced labor costs. A study of New York City taxis found that for every 10% decrease in taxi cost, taxi trips increased by 2.2%. Few peer-reviewed studies evaluate the effects of reduced insurance costs for personal AVs.

AVs will enable new travelers. Studies estimate that AVs will allow new passengers who previously did not have access to mobility, including disabled, senior, and under-age riders to travel independently. New customers are expected to account for an increase in VMT of 10–14%.

Parking and relocation travel effects are mixed. Personal AVs and AV taxis may reduce parking demand by 90%. However, reduced parking may increase relocation travel as AVs return to their 'home base' or drive to pick up new riders. The magnitude of effects of relocation travel on VMT is still uncertain, but it is expected to exacerbate VMT and congestion, particularly in city centers.

The net effects are negative. This review of modeling studies to date suggests that the net effects of the above mechanisms will lead to an increase in VMT and GHG emissions, as well as increased suburban sprawl and added congestion in city centers.

Policy Recommendations

Electrify AV fleets. Policy that encourages automated vehicles to use electric powertrains will dramatically reduce GHG emissions and help governments achieve their GHG emissions goals. However, it is possible that the minor reductions in vehicle operating costs of EVs may further increase travel demand and VMT.

Encourage AV sharing. Travel demand increases can be offset if more AV taxi consumers share, or pool, rides. Policy will play a critical role in ensuring more consumers choose to pool rides. Pricing policies can deepen discounts for shared taxi fares. Curb and road access policies can also reinforce monetary incentives by providing time savings for pooling and offsetting time costs associated with pooling.

Reduce congestion in city centers. Reinvesting in high-frequency, high-quality mass transit along dense urban corridors will reduce relocation travel and congestion for the metro region. AVs can serve as expanded first- and last-mile service shuttles connecting riders to high-quality transit corridors and lower-density neighborhoods. Cordon area congestion pricing policies can also discourage AV travel within city centers.

Further Reading

This policy brief is based on "Travel Effects and Associated Greenhouse Gas Emissions of Automated Vehicles," a white paper from the National Center for Sustainable Transportation and the 3 Revolutions Future Mobility Program, prepared by Caroline Rodier of the University of California, Davis, with support from USDOT. To download the white paper, visit: https://ncst.ucdavis.edu/white-paper/travel-effects-and-associated-ghg-emissions-of-avs/

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[i] *Underwood, Steven E. "Disruptive innovation on the path to sustainable mobility: creating a roadmap for road transportation in the United States." In Road Vehicle Automation, pp. 157-168. Springer International Publishing, 2014.*

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