Sharing, Electrification and Automation
3 REVOLUTIONS

ITS UC DAVIS INSTITUTE OF TRANSPORTATION STUDIES

Policy Brief

April 2017

Keeping Vehicle Use and Greenhouse Gas Emissions in Check in a Driverless Vehicle World

Co-Authors:
Giovanni Circella, University of California at Davis
Chris Ganson, Governor's Office of Planning and Research*
Caroline Rodier, University of California at Davis

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In November 2016, the Institute of Transportation Studies at the University of California, Davis (ITS-Davis) convened leading academic, government, private industry, and public interest stakeholders to explore science-based policies that could steer the three transportation revolutions- shared mobility, electrification, and autonomous vehicles, toward the public interest.

This policy brief reflects the opinions of the authors and not UC Davis. This brief is one in a series that presents a range of policy concepts, recommendations and research needs discussed at the 3 Revolutions Conference.

Contact: Mollie D'Agostino mdagostino@ucdavis.edu with additional questions.

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Summary of Policy Recommendations

To support VMT and GHG containment goals:
1. Deploy driverless vehicles as shared use vehicles, rather than privately owned
2. Ensure widespread carpooling
3. Deploy driverless vehicles with zero tailpipe emissions
4. Take advantage of opportunities to introduce pricing
5. Increase line haul transit use rather than replacing it
6. Ensure driverless vehicles are not larger or more energy consumptive
7. Program vehicle behavior to improve livability, safety and comfort on surface streets

Introduction

Driverless vehicles are likely to profoundly affect transportation patterns and ultimately reshape cities. Their deployment creates substantial risk to vehicle miles traveled (VMT) and greenhouse gas (GHG) containment, but also substantial opportunity. Driverless technology could be deployed along very divergent pathways, and at this early stage, policy has the opportunity to affect which path is taken. Because California is at the epicenter of driverless technology development, such policy could influence deployment pathways nationally or even globally. Given transportation's large share of GHG emissions, California's influence could conceivably tip national, or even global, GHG emissions trajectories sufficiently to enable or prevent attainment of science-based climate goals.

Understanding what a driverless vehicle world might look like is challenging. Driverless vehicles are not yet publicly available, so we do not yet have empirical data on how they will affect travel behavior. Nevertheless, researchers have extrapolated from existing travel behavior research to make estimates of likely effects. Among other research being developed in this area, the research activities funded through the National Cooperative Highway Research Program (NCHRP) 20-102 are specifically investigating the "Impacts of Connected Vehicles and Automated Vehicles on State and Local Transportation Agencies". Major components of those effects are listed in Table 1 and Table 2.

Table 1. Component effects of driverless vehicle deployment

Effect Component	VMT	GHGs
Automation makes car travel less onerous, leading to more of it	↑	↑
Zero-passenger trips for errands, fetching people, or parking remotely	↑	↑
Car trips replace line-haul (e.g. subway) transit trips	↑	↑
Car trips replace subsistence (e.g. peripheral bus) transit trips	↑	↓
Better first- and last-mile connectivity to transit increases transit patronage and reduces car trips	↓	↓
Car trips replace bike and walk trips	↑	↑
Potentially faster permeation of ZEVs		↓
Vehicle size and design changes		↑ ↓
Increased comfort and reduced value of travel time allow for residential locations in more remote locations (where land is cheaper)	↑	↑

Table 2. Component effects of shared vehicle deployment

Potential Effect	VMT	GHGs
Travelers face full cost of vehicle use on each trip (rather than already having invested in a vehicle, paid insurance, etc.)	↓	↓
Increased carpooling	↓	↓

In addition to direct effects, driverless vehicles will lead to changes in land use patterns that could support or undermine VMT and climate goals. For example, a shared-use deployment might allow reduction in land devoted to parking and allow densification of urban cores; meanwhile, low-cost, low-impedance driverless travel could lead to "supersprawl."

Policy Recommendations

The remainder of this brief is devoted to outlining the policy needs listed above. The following policy concepts can support VMT and GHG containment goals:

1) Deploy driverless vehicles as shared-use vehicles, rather than privately owned.

Driverless vehicles will decrease the impedance (i.e., travel time costs) to vehicle travel, leading to more trips, longer trips, and a greater proportion of trips taken by automobile. A study that analyzed the impact of the activities conducted while traveling on the propensity to use travel modes suggested that the ability to use time productively while riding in a driverless vehicle (which is only one component of the potential effects of AVs) could significantly reduce the mode share for rail services (Malokin et al., 2015). If driverless vehicles are privately owned, they would cause substantial additional VMT and GHGs and additional sprawl (Fagnant, Kockelman 2016). Deploying driverless vehicles in a shared fashion (deployed through transportation network companies (TNCs) and/or through public agencies) would remove the sunk cost of auto ownership, and a traveler would experience the full cost of vehicle travel on each trip, mitigating the VMT increases from the reduction in impedance. A shared-vehicle deployment would also free up parking for infill development, allowing greater density and increased walkability. Shared use driverless vehicle deployment would still likely lead to increases in VMT, though much more moderate increases than if they were privately owned. If shared vehicles are zero-emissions, they could lead to moderate GHG emissions reduction (Greenblatt, Shaheen 2015 and Greenblatt, Saxena 2015).

2) Ensure widespread carpooling.

Only if driverless vehicles are deployed through both shared ownership and shared rides is VMT likely to decrease. An idealized deployment of shared use and shared ride vehicles, coordinated with transit, could reduce VMT by a quarter, GHGs by a third, and travel costs by half to three quarters, while maintaining or improving access to destinations for all. However, massive adoption of a shared-ownership and shared-ride operation model for driverless vehicles is not likely to happen without a strong policy framework or system of incentives that encourages it.

3) Deploy driverless vehicles as zero tailpipe emissions vehicles.

If driverless vehicles are deployed in a shared-use, shared-ride fashion, ensuring they are zero tailpipe emission vehicles would further speed GHG reduction (assuming continued progress decarbonizing electricity). If they are deployed in a shared-use fashion but without ridesharing, then there may be an increase in VMT, and zero tailpipe emissions deployment would be needed to remain on course to achieve GHG targets. If they are deployed as privately owned vehicles, it is possible that VMT increases would be great enough that even a zero tailpipe emissions deployment would not be sufficient to prevent an overshooting of GHG targets (Wagner et al 2014).

4) Take advantage of opportunities to introduce pricing.

Deployment of this new class of vehicles both creates unprecedented need, and provides unprecedented opportunity, for pricing of roadways and curb space. The reduced impedance of driverless vehicle travel will, all else equal, increase VMT and congestion; pricing is the best-proven strategy for reducing VMT and congestion.

Strategically deployed pricing could also:

- Increase carpooling and transit use
- Reduce congestion
- Reduce lower-value vehicle movements (e.g. relocation of empty vehicles)
- Cover maintenance and other transportation funding shortfalls
- Reduce sprawl and consumption of working lands
- Reduce noise, emissions, and other impacts associated with higher VMT
- Improve health outcomes by leading to greater active transportation mode share

Pricing could be deployed in shared use vehicles through transportation network companies, potentially solving technical, privacy, and political challenges because the companies rather than individuals would be charged. TNC pricing based on driver availability ("surge pricing") is already well-accepted; it would simply need to be expanded to include the availability of roadway capacity. Pricing that varies by location and time of day demand would be an important component to reducing potential congestion during peak travel times. Even with ridesharing, automated vehicles will increase the effective capacity on roadways, which will increase traffic flow to dense employment areas. It may not be desirable or possible to expand roadway capacity in these areas. In addition, parking queues for drop-off travel during peak periods could further add to congestion.

5) Increase line haul transit use rather than replacing it.

Driverless vehicles could improve first- and last-mile connections to high-quality transit, expanding transit catchment areas and increasing ridership, but pricing or other policy intervention may be needed. Some jurisdictions, such as the City of Sacramento (during events at its downtown arena), are already implementing differentiated pricing (e.g. subsidies) for shared vehicle trips to transit. Without pricing or other intervention, driverless vehicle travel may be sufficiently inexpensive to largely replace line-haul transit, leading to VMT and GHGs increases and worsening congestion, as well as undermining a central organizing principle for land use and causing sprawl. Meanwhile, driverless vehicles could replace underutilized subsistence bus routes with substantial cost savings, potentially benefiting both GHG reduction and access to destinations. Line-haul transit that serves concentrations of high population origin and destination locations is likely to provide greater people throughput than would driverless vehicles. This may be particularly true where limited roadway capacity in central business districts areas limit the number of entering vehicles.

6) Ensure driverless vehicles are not larger or more energy consumptive.

Without the need for a front-facing driver, vehicle shape and size are likely to change. Shared use systems could allow choosing vehicles of the right size for the task at hand, rather than requiring a vehicle large enough to handle all tasks. On the other hand, with attention to the road no longer needed, demand for larger vehicles that could house other activities (offices, kitchens, movie theaters, exercise equipment, etc.) could lead to increases in energy use and emissions. Vehicle length also significantly affects traffic flow on surface streets; for example, short vehicles can flow in greater numbers through a signalized intersection than larger ones (Anderson 2014).

7) Program vehicle behavior to improve livability, safety and comfort on surface streets.

With vehicle behavior determined by computer algorithm rather than human behavior, it is more readily subject to policy, creating the potential to improve the safety and comfort of fellow road users and improving neighborhoods. Perceived auto collision risk is the top impediment to cycling (Geller, Portland Bureau of Transportation), so improving real and perceived safety could lead to substantial increases in cycling and substantial environmental and health benefits. NACTO recommends a 25 MPH speed limit on urban streets for driverless vehicles, to reduce pedestrian and cyclist fatalities. Buffer distances could also be programmed to prioritize safeguarding of vulnerable road users. NACTO points out that partially-automated vehicles have been demonstrated to lead to poor driver attention, and recommends prohibiting such systems in urban areas.

Opportunities for Future Research

- Improved understanding of system level effects of driverless vehicles systems at micro and macro levels.
- Behavioral studies that can help understand the impact of driverless vehicles on the travel and activity scheduling, mode choice, time allocation and household interactions (e.g. due to the reduced needs for escorting purposes, and driverless vehicles' ability to drop off a passenger and reposition themselves at another location).
- Policy instruments to encourage ridesharing among a broader range of socio-economic groups in different geographic contexts; expand electric vehicles fleets in existing shared use mobility services; and implement pricing structures.
- Evaluation of the willingness to pay of users for different types of services, e.g. shared vehicles vs. privately-owned vehicles, ridesharing, and changes in the evaluation of the value of travel time, in order to better calibrate incentives and policy to regulate AVs.
- Improve and apply methods that use available data to build institutional capacity and improve need and alternative analyses for shorter term policy guidance.

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Acknowledgements:

Support for the 3 Revolutions comes from the following partners:

Climate Works
The Energy Foundation
The 11th Hour Project (The Schmidt Family Foundation)
Pices Foundation
The National Center for Sustainable Transportation
The University of California Institute of Transportation Studies