Decarbonizing travel in cities with electrified autonomous taxis

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Deploying a fleet of electric autonomous taxis in a city could result in an 87 percent reduction in greenhouse gas emissions compared to conventional vehicular travel, according to a new University of Michigan-

led study.

The electrification of a city's AT fleet—largely from electric powertrains—results in a 60 percent reduction of greenhouse gas emissions compared to the baseline of personally owned, human-driven vehicles.

However, study author Gregory Keoleian, director of U-M's Center for Sustainable Systems at the School for Environment and Sustainability, says that the autonomous nature of the taxi fleet is integral to further GHG reductions—up to 87 percent.

"With the autonomous fleet, you have a net benefit in greenhouse gas reductions that you don't have with a standard taxi fleet," he said. "Due to capabilities such as smoother acceleration and communication between vehicles and infrastructure, autonomous vehicles create a direct effect benefit in GHG reduction and improve overall fuel economy."

In addition to an AT fleet's "direct effect" GHG reduction, implementation can lead to further sustainability improvements through "indirect effects" related to fleet size and parking and charging infrastructure.

"With greater vehicle utilization and occupancy, fleet sizes can be reduced and mitigate a parking burden, and fleets will turn over more frequently, adopting more efficient technology sooner," said study co-author Jim Gawron.

An AT fleet would likely reduce the cost of charging infrastructure, and dynamic ride-sharing can reduce vehicle miles traveled. Furthermore, the researchers believe that electrification of autonomous taxis could accelerate electric vehicle sales, perhaps amplifying desired outcomes.

The research, published July 1 in the journal Transportation Research Part D: Transport and Environment, was performed by Keoleian, Gawron and colleagues at Ford Motor Company's Research and Innovation Center.

The researchers utilized a simulated electric autonomous taxi fleet in Austin, Texas, that would service 10 percent of the current travel demand in Austin from 2020 to 2050 (for passengers with an average of 10 minutes waiting time). They examined a total of nine different scenarios in which AT fleets were used.

The researchers' ultimate objective was to build upon their previous research that looked exclusively at comparing personally owned connected and automated vehicles with human-driven vehicles.

The Austin simulations, however, examined electric AT implementation on a broader system level and in a realistic city setting.

Keoleian believes there are a few imperatives to enhance the sustainability of future mobility systems.

"In addition to electrification, we need greater vehicle occupancy and better match for vehicle size to rider demand," he said. "Autonomous taxis can play an important role in implementing these changes to our mobility system."

Keoleian is a professor of sustainable systems and civil and environmental engineering. Gawron is an MS/MBA graduate of U-M's School for Environment and Sustainability and Ross School of Business. He was recently hired as an investor relations manager at Ford, working to further improve the company's sustainable mobility efforts.

More information: James H. Gawron et al. Life Cycle Assessment of

Connected and Automated Vehicles: Sensing and Computing Subsystem and Vehicle Level Effects, *Environmental Science & Technology* (2018). DOI: 10.1021/acs.est.7b04576

James H. Gawron et al. Deep decarbonization from electrified autonomous taxi fleets: Life cycle assessment and case study in Austin, TX, *Transportation Research Part D: Transport and Environment* (2019). DOI: 10.1016/j.trd.2019.06.007