National Center for Sustainable Transportation

POLICY BRIEF

Planning Can Maximize Benefits and Mitigate Negative Consequences of Future Travel Increases from E-Commerce

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August 2022

Issue

Last-mile delivery, in which companies deliver goods to the end consumers, is one of the costliest segments of the supply chain and can generate significant emissions. The demand for last-mile delivery has grown in recent decades because of the emergence of e-commerce, which has reshaped consumer behavior and how companies distribute goods. E-commerce has consistently been growing for more than a decade, and growth intensified during the COVID-19 pandemic. Although e-commerce is still in a fast growth phase, there is little understanding about how much it will grow, how it will impact the transportation system, and how these impacts might differ geographically.

Researchers at the University of California, Davis developed a forecasting model to quantify the potential impacts of future e-commerce on emissions and transport activity under different scenarios with assumptions about penetration levels of various technologies (e.g., electrification, rush deliveries, crowdshipping, and automation/efficiency improvements). The researchers implemented the forecasting tool in six large metropolitan areas: New York, Los Angeles, San Francisco, Dallas, Washington D.C., and Chicago. These analyses can help planning agencies and local governments to better understand and manage the potential impacts of e-commerce.

Key Research Findings

The impacts of shopping behavior are expected to differ from one metropolitan area to the next. The researchers forecasted that San Francisco and New York will experience more growth in online shopping, while Dallas and Los Angeles will see more in-store and hybrid (a combination of in-store and online) shopping behavior. For example, New York is expected to see daily in-store, online, and hybrid shopping behaviors generating an increase in vehicle miles traveled (VMT) of 76%, 140%, and 291% respectively by 2050, while Dallas is expected to experience an 80% increase in VMT attributable to in-store shopping and a 48% decrease in VMT from online shopping.

Differences in shopping impacts are due to assumptions in forecasted growth, trends in demographics, and associated shopping behaviors. Age, gender, income, and mobility difficulties are all significant influencing factors for in-person shopping and can have different positive and negative influences in different areas. For example, being female was a significant factor in making in-store shopping behavior more likely in New York, Chicago, and Washington. It made in-store shopping less likely in Los Angeles and Dallas. Differences in shopping-related travel and mode also affect the impacts of shopping activity. Los Angeles and Dallas exhibit the largest travel distances and highest proportion of private vehicle use for shopping trips, while New York has the highest proportion of shopping trips using public transit.

In some cases, increases in VMT associated with online shopping could be counteracted by reductions in in-store shopping travel. Some metropolitan areas are expected to see an increase in delivery VMT accompanied by a reduction in shopping travel VMT, with a net decrease in VMT. However, the overall emissions impact of these shifts will be dependent on the fleet used and the type of services (e.g., fast shipping, pick-up in store).

Land-use planning has an important role in determining the overall effects of shopping on

VMT and associated emissions. Although in-store shopping travel distances were the highest in Los Angeles, the region also had the greatest overlap between the population and freight transportation service distribution areas among the metropolitan areas studied. The relatively short goods distribution trips associated with online shopping resulted in lower relative increases in VMT compared with other areas in which goods need to travel farther from warehouses to the final consumer.

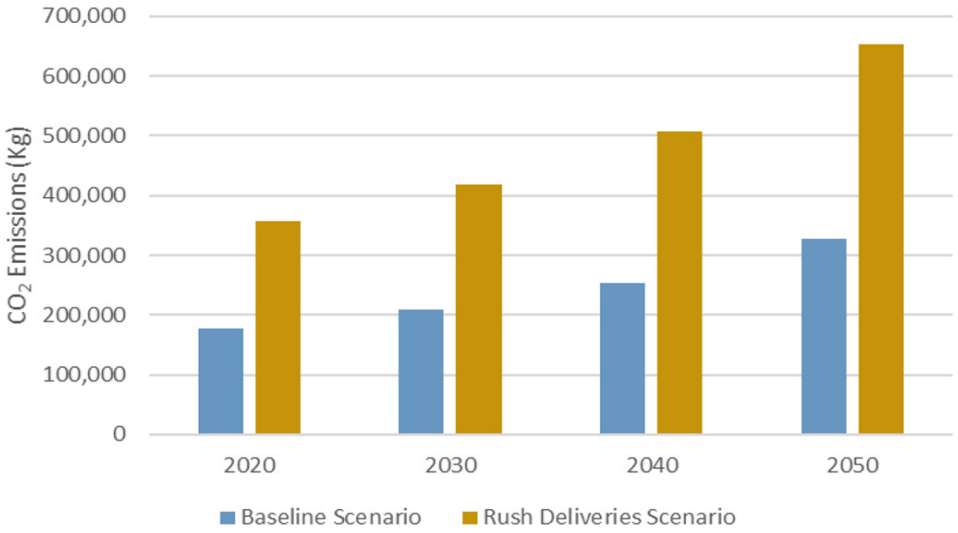

Figure 1. Carbon dioxide (CO_2) emissions associated with online shopping in New York under a baseline scenario and a rush deliveries scenario in which there is a 50% reduction in goods consolidation.

Cleaner vehicle technologies will help curb the environmental impacts of shopping travel and distribution. Empirical analyses show that if 25%–30% of vehicles used for personal shopping travel and commercial deliveries are zero-emission, the result will be a significant reduction in emissions compared to the fleet mix of today.

Faster delivery services will have negative environmental consequences due to the lack of cargo consolidation. If there is not a good supporting distribution infrastructure, results show that fast delivery services would potentially increase distribution VMT by 300% and emissions by 200% (without considering a cleaner fleet) (Figure 1).

Automated deliveries can offer significant environmental benefits. Under the modeling assumptions, and consistent with prior research, the researchers found that deliveries using drones, autonomous mobile robots, or autonomous vehicles can reduce VMT and emissions by around 25%, though each of those technologies will have specific applications.

Policy Implications

This study suggests that strategies aimed at cleaning the vehicle fleet (both personal and commercial delivery) will reduce the environmental effects of shopping activities, as will future land-use planning to improve the efficiency of the distribution system by reducing unnecessary travel caused by longer distances to freight facilities. Strategies will also be needed to avoid the low efficiency of less consolidated routes that result from fast delivery services or sparse distribution networks. The researchers' forecasting modeling tool can help local and regional agencies monitor and evaluate future system conditions and can be applied to any geographic location.

More Information

This policy brief is drawn from "National Impacts of E-commerce Growth: Development of a Spatial Demand-Based Tool," a report from the National Center for Sustainable Transportation, authored by Miguel Jaller, Ivan Xiao, Sarah Dennis, and Daniel River-Royero of the University of California, Davis. The full report can be found on the NCST website at https://ncst.ucdavis.edu/project/national-impacts-e-commerce-growth-development-spatial-demand-based-tool.

For more information about the findings presented in

DOI: 10.7922/G2QZ289K