Evolution of the household vehicle fleet: Anticipating fleet composition, PHEV adoption and GHG emissions in Austin, Texas

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Abstract
The transportation sector is responsible for a quarter of the world's anthropogenic emissions of greenhouse gases (GHG), and personal transport dominates this share. Policymakers, planners, engineers, scientists, and practitioners seek effective ways and means to anticipate and control the increasing trend in GHG emissions for a sustainable future. Rising gasoline prices, emerging engine technologies, and changes in fuel-economy policy are anticipated to result in a variety of behavioral changes. These include adjustments in vehicle occupancies, trip destinations, trip chaining, and mode choice in the short term. In the longer term, a wider sphere of decisions will be affected, including household vehicle holdings (number, make and model), vehicle purchase and retirement timing, and home and work location choices. Policymakers, planners and travel demand modelers wonder what the short- and long-term outlooks are.

This work develops new data sets and evaluates near- and long-term decisions of vehicle owners in order to anticipate evolution of the vehicle fleet, vehicle-miles traveled, emissions of greenhouse gases from personal transport, and welfare effects of various policies. The behavioral models will be applied across a variety of scenarios, including rising fuel prices, cap and trade policies across vehicle manufacturers (to attain certain fleet-level fuel economy standards), vehicle scrappage ("early retirement") policies, use of feebates (which benefit those purchasing more efficient vehicles and tax those buying "gas guzzlers"), and the like. Models of different events in the vehicle ownership-and-use process will be developed for the Austin, Texas region, by make and model, including purchase and retirement. Vehicle and trip datasets from Austin's 2006 Travel Survey and recent surveys of vehicle purchase, use and retirement decisions will be used. Joint models of vehicle number and type, use levels, and holding durations will be estimated using multiple discrete-continuous extreme value (MDCEV) and other, utility-based specifications. The effects of land use patterns, transit accessibility, the built environment, and various demographic factors will be explored.

To achieve a stabilization of greenhouse gas emissions from transport, it is necessary to understand the extent of behavioral change brought about by policy. Although, there is a tendency to focus on long-term technological solutions, short-term behavioral changes are also likely to be critical in realizing the carbon-reduction benefits of new technologies. Personal surveys will be obtained from over 500 residents of Austin, including information on sensitivity to gasoline prices, opinions about different vehicle technologies, anticipated responses to various energy policies, and opinions on climate change issues and initiatives. The data recorded for individuals will be weighted across different income groups, age categories and education levels in order to correct for sampling biases and analyzed using ordered probit, MDCEV and other models. Such data will indicate which policies may receive the most public support and/or be most effective. The effects of these policies will be micro-simulated using a synthetic population, to anticipate the region's future passenger vehicle fleet and the impacts of different policies 25 years or more in the future. Simulations of the U.S. vehicle market may be pursued as well, further demonstrating use of these models. If reasonable, user-friendly model code will be developed for use by others wishing to test the impact of new vehicle designs, gas prices, policies and their combinations.

Of course, as fuel economy rises, driving costs per mile fall, encouraging a rebound effect, which will be
implicit in the simulations. Nevertheless, simulation results are likely to indicate that various combinations of new technologies and pricing policies can shift the region and the nation towards the dramatic cuts in carbon emissions (50 to 80% by 2050) that are needed to stabilize the planet's climate. Thanks to their foundation in utility-maximization theory, the models will lend themselves to welfare calculations, which will provide information on how beneficial or costly different vehicle options, policies and pricing environments are for the population at large.