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LRRB
LOCAL ROAD RESEARCH BOARD

TECHNICAL SUMMARY

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PROJECT COST:
$100,767

Investigators attached data loggers to county vehicles to track driving practices and fuel consumption.

DEPARTMENT OF TRANSPORTATION
OFFICE OF RESEARCH & INNOVATION

Evaluating the Use of Hybrid Vehicles in Municipal Fleets

Vehicle data assisted local fleet managers in evaluating the potential benefits of adding hybrid vehicles to municipal fleets. Hybrids offer significant fuel economy for urban stop-and-go applications, but conventional vehicles may be better-suited for rural needs.

What Was the Need?

The availability of hybrid electric utility vehicles expands the field of choices for a fleet manager looking to replace or expand fleets. In order to justify new vehicle purchases, fleet managers of local agencies need to determine how choices impact budgets and operations.

Calculating the fuel costs, service lives and versatility of new cars and trucks is one facet of a decision-making process that must consider funding levels and budgets, political and environmental goals of municipal authorities, and various uses of vehicles in municipal services. If county leadership, for example, publicly pursues reducing greenhouse gas emissions, environmental impacts associated with using new hybrid pickup trucks may take precedence over life cycle costs or multiple uses of vehicles.

Manufacturers of hybrid vehicles often describe the fuel savings or financial benefits of their products, but these claims are rarely validated by third parties. Public fleet managers do not have a method for weighing the fuel economy benefits of hybrid versus conventional vehicles outside of manufacturers' claims, which may not be reliable or applicable to a municipal fleet's needs.

What Was Our Goal?

Researchers sought to determine the fuel consumption benefits of hybrid utility vehicles for municipal fleets. The research team aimed to determine what routes and usages generated high fuel consumption in representative Minnesota municipal fleet activities, which vehicle technology delivered lower consumption on chosen routes, and the basic cost-effectiveness of technologies in specific uses.

What Did We Do?

Data loggers were installed on conventional half-ton pickups, ¾-ton pickups and SUVs in fleets from MnDOT, Minnesota Department of Natural Resources, Minnesota Department of Administration, Dakota County, Ramsey County, Washington County, City of Bloomington, City of Minneapolis and City of St. Paul. From September 2018 through April 2019, vehicle speed, engine revolutions, air flow and fuel consumption data was collected and transmitted to a university data drive.

The research team then developed vehicle simulations based on logger data and manufacturer fuel consumption claims for conventional, hybrid gas-electric and hybrid charge-depleting plug-in vehicles that use gasoline and electric systems with supplemental plug-in recharging. Researchers validated models with data from a hybrid gas-electric police department van in Dakota County collected in August 2018.

Investigators analyzed daily vehicle use in terms of average speed, fuel consumption and kinetic intensity, a measure of force that balances acceleration and aerodynamic drag and works well in analyzing fuel requirements in urban and rural settings.

continued

"This study gives fleet managers a tool for gauging the benefits of adding hybrid vehicles to their fleets. Determining how the equipment will be used is key in the decision-making process."

—Kevin Schlangen,
Fleet Manager, Dakota County

"We used driving cycles that were realistic and ran a model that was not computationally intense. The results indicate that putting hybrids on urban routes will provide the biggest benefits."

—Will Northrop,
Associate Professor, University of Minnesota Department of Mechanical Engineering

Researchers took driving data from several city, county and state vehicles and modeled the impact of hybrid and plug-in hybrid vehicles like this one on fuel consumption.

What Did We Learn?

Research shows that even a slight benefit in fuel economy can save substantial taxpayer costs. Dakota County's municipal fleet consumes about $540,000 in fuel each year. Benefits from hybrids have the potential to save fuel costs and reduce emissions of nitrogen, carbon monoxide and carbon dioxide.

Equipment problems and vehicle access challenges limited data logging, particularly with half-ton pickups and SUVs. Analysis was substantially based on data gathered from ¾-ton pickup use in fall and winter. Unlike standard, federally regulated fuel economy testing used by vehicle manufacturers, researchers were able to model hybrid performance based on actual vehicle use as detailed via logger data.

Hybrid performance benefits improved in cold weather conditions due to lower vehicle speeds, less aggressive driving and technologies that regenerate battery power with braking force. Plug-in hybrids offer greater fuel economy benefits than more conventional hybrids. Researchers determined that usage patterns significantly impact fuel consumption improvements that fleet managers can realize from using hybrid vehicles.

Hybrid performance for duties and routes that entail significant use of arterials or highways provided only modest benefit—about a 5% improvement in fuel consumption. However, hybrids used in urban stop-and-go applications offered more significant benefit, with 20% to 25% improvement in fuel consumption. Idling time significantly increased fuel consumption; idling for over 50% of a drive cycle reduced fuel economy by 10% in ¾-ton pickups.

For rural and highway routes, the research team recommends that local fleet managers rely on conventionally powered vehicles, which typically cost less to purchase, but consider hybrids for urban routes or those with a lot of stop-and-go conditions. The team also cautions that aggressive driving reduces fuel economy and should be avoided.

What's Next?

Although an optimal mix of conventional and hybrid motor vehicles is not available for municipal fleets, this study gives local fleet managers a preliminary look at the benefits that they may realize with certain uses of hybrid vehicles. Fleet managers would benefit from expanding this analysis to a larger fleet and including alternative powertrains like those for hydrogen-powered or all-electric vehicles, as technologies become commercially available.

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