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Hybrid Cars Do Well in Assessments of the Environmental Impact of Urban Vehicles

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Transportation uses vast amounts of energy and has a major environmental impact. As a result, rigorous assessments of the sustainability of various modes of moving people and goods are critically important. Alternative fuels and electric vehicles are two major developments that can help transportation planners reduce the detrimental environmental impact of transportation. After many studies, it turns out that the highest environmental-friendly scores go to hybrid diesel-electric buses, while the lowest scores go to vehicles reliant on gasoline internal combustion engines. Among all passenger vehicles, fuel cell and hybrid gasoline-electric vehicles have the highest sustainability indexes. But these scores are not everything, of course, because some new types of vehicles are less suitable and convenient or still experience limits in size, engine and battery performance, and a limited availability of charging stations.

Assessing Sustainability

When evaluating transportation modes, considerations about environmental effects and sustainability must be considered along with issues of technology and ease of use over the lifetime of the vehicle. Officials need to take all these factors into account in making choices about modes of transportation and when justifying their decisions to the public as safe and convenient. Officials need to understand many features of various types of vehicles, including how alternative propulsion systems might be used over their lifetimes.

Vehicle type in this context refers to the basic types (cars, vans, light duty trucks, buses, and so forth) and also to propulsion technologies such as internal combustion engines, electric motors or hybrids. All vehicles studied by my colleagues and I were assumed to use the same highways (thus roads and related traffic infrastructure were not part of the sustainability assessment). We compared seven 2011 model-year vehicles of the following types: internal combustion engine vehicle, hybrid electric vehicle, fuel cell vehicle, electric vehicle, plug-in hybrid electric vehicle, diesel bus, and hybrid diesel electric bus. A specific vehicle was selected for each type based on highest sales volume – that is, the 4 cylinder Toyota Camry represented internal combustion engine vehicle, the Toyota Prius represented hybrid electric vehicle, and so forth.

To approximate what a comprehensive transportation plan would need to include, data were collected about five sustainability facets for each vehicle type – measuring environmental impact, technology performance, energy, economy, and user experience.

For Sustainability, There are Clearly Superior Choices

Using prevailing vehicle occupancy rates (persons per vehicle) for U.S. cities, the rankings below indicate that the superior choice is the bus, with the hybrid version being better than the common diesel bus. However,

buses rarely serve more than five percent of trips people take in cities. Most trips are made in cars and similar light duty vehicles, and for such trips the hybrid electric vehicle is the superior choice. And this kind of vehicle becomes the top pro-sustainability choice when it serves as a taxi or ride-sharing vehicle.

Vehicle Sustainability Rankings							
Vehicle Type	Internal Combustion Engine	Hybrid Electric	Fuel Cell	Electric	Plug-in Hybrid	Diesel Bus	Hybrid Diesel Electric Bus
Vehicle Miles of Travel	5	1	2	4	3	7	6
Passenger Miles of Travel (Average Load)	7	4	3	5	6	2	1
Passenger Miles of Travel (Two People)	7	1	2	3	5	6	4
Average load is 1.2 persons per vehicle for light duty vehicles and 10.5 for buses.							

Are there special barriers to the spread of these environmentally optimal vehicles? In the short term, there are no barriers to be overcome to increase the penetration of hybrid electric vehicles in the market. Hybrids avoid running into barriers such as a lack of maintenance and repair shops or lack of familiarity with the operation, range and charging of fuel cell vehicles, electric vehicles, and plug-in electric vehicles.

Future Prospects

Over the long term, fully electric and fuel cell vehicles have the potential to reduce environmental impact even more. In advanced countries, car ownership per household is likely to decrease due to: aging and lower birth rates as well as due to spreading restrictions on certain types of automobiles that cause high levels of pollution or congestion. Transportation in many places may become more of a shared service provided by Lyft or Uber or autonomous taxis. As this happens, the expectation is that electric vehicles will increasingly become a replacement for fossil-fuel-powered, light-duty vehicles.

Electric-drive vehicles are becoming more capable and, because they are particularly suitable for polluted environments, they have the potential to become the dominant type of light-duty passenger service vehicle in large urban areas. Transition times will depend on purchase prices and regulations. As long as manufacturers of gasoline-powered vehicles offer substantial performance and technological and safety improvements for (the 2018 price of) $25,000, electric drive vehicles priced above $35,000 will have difficulty gaining a large market share.

In the developing world, light-duty vehicles costing more than $15,000 are too expensive. However, electric buses and light delivery vehicles such as scooters and tricycles are likely to gain in polluted cities such as Cairo, New Delhi, Dhaka, Kathmandu, and most large cities in China.

Together, new environmental policies and the increasing availability of alternative-fuel vehicles support the creation of a more sustainable transportation system. Current policies should be focused on improving the fuel efficiency of vehicles and on lowering the purchase price of hybrid electric vehicles, even as electric-drive vehicle technologies improve their cost-performance ratio. If these possibilities continue to reach fruition, the future of sustainable urban transportation is bright.

Read more in Lambros Mitropoulos and Panos Prevedouros, "Emissions and Cost Model for Urban Light Duty Vehicles" *Transportation Research Part D: Transport and Environment*, 41, (2015): 147-159.