Title
Charge It: The Promise of Plug-in Electric Hybrids

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Charge It: The Promise of Plug-in Electric Hybrids

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ISSUE

With rising energy prices and battery improvements, the plug-in hybrid electric vehicle, a variant of the better-known self-charging hybrid electric vehicle, is fast gaining popularity. Because plug-in hybrids can recharge via a wall socket while resting, they can run purely on electric power for many trips without having to revert to gasoline. This significantly reduces emissions over conventional hybrids, which can only recharge while they're operating and are thus more likely to rely on their internal combustion engine when in use. The driving range of plug-in hybrids running on electricity varies from 10 to 60 miles. Surveys show that about 50 percent of passenger vehicles in California log fewer than 20 miles in a day; about 80 percent log fewer than 60 miles. Such short trips are well-suited to purely electric-powered travel.

Compared to gasoline-electric hybrids, plug-in hybrids have the potential to eliminate more gasoline-powered trips and miles traveled, which in turn reduces emissions even more than traditional hybrids. Levels of environmental benefits are determined by a region's electrical grid and energy profile.

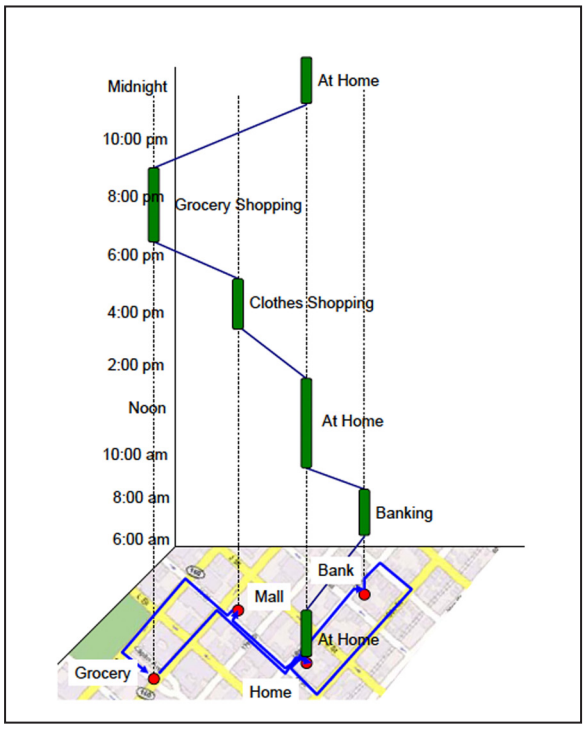
To better understand their potential for reducing vehicle-caused emissions, three key questions about plug-in hybrids must be answered: 1) can they reduce gasoline-assisted vehicle trips and miles traveled? (2) will they impose undue burdens on generating capacity and infrastructure? and (3) what will be their net effect on overall emissions (factoring in inefficiency of electricity generation and transmission over long distances and type of fuel used to create electricity) and other environmental costs (e.g., battery manufacture and disposal)?

Existing studies are almost exclusively based on aggregate estimates of vehicle-miles-traveled and projected future demand. By contrast, we gauged plug-in hybrids' performance based on actual usage patterns. The impacts of plug-in hybrids on gasoline consumption and electricity demand were estimated using data from the 2000-2001 California Statewide Household Travel Survey. Estimates were made at various assumed electricity prices and improvements in charging infrastructure to reflect the high demands placed on the grid during periods of peak consumption. We tested

and compared four different charging scenarios: 1) recharging at the end of the travel day, 2) unlimited charging at home, 3) limited home charging (10 p.m. or later, after demand has peaked), and 4) charging at home combined with publicly-available charging (at parking spaces equipped with outlets).

RESEARCH FINDINGS

Our study found that a simple upgrade from 120-volt to 240-volt charging outlets allowed for charging durations that better align with the shorter average time spent when shopping and running errands. Higher voltages can also better accommodate short-term home charging during the day. (See figure at left.) Daytime home charging can potentially service 40 to 50 percent of total travel distances with electric power for 20-mile-per-day users and 70 to 80 percent for those who travel 60 miles per day. Equipping public parking spaces with charging facilities can potentially convert 60 to 70 percent of total mileage from gasoline to electricity for lower-mileage users, and 80 to 90 percent for higher users. Even greater emission reductions could be achieved. Daytime charging would, however, increase the peak demand for electricity.



The time (vertical axis) and spatial (horizontal axis) profile of daily travel is diagrammed for a surveyed California driver. Most vehicle trips are of short duration and distance. At stops along the way, a plug-in vehicle could restore its charge and avoid having to rely on gasoline power.

RECOMMENDATIONS

This study found that plug-in hybrids can significantly reduce emissions and energy consumption in urban settings where average trip distances are fairly short. The ability of plug-in hybrids to deliver environmental benefits will rely heavily on initiatives that reduce charging times and provide wider opportunities for charging outside the home. In this regard, we recommend enacting policies that 1) encourage affordable conversion from 120-volt to 240-volt charging at home and 2) provide for installation of 240-volt charging facilities at public and private parking facilities adjacent to major activity centers, like shopping malls and rail transit stations.

This policy brief is a product of the University of California Transportation Center, located at UC Berkeley: 2614 Dwight Way, Berkeley, CA, 94720. It is drawn from the full report, "An Activity-Based Assessment of the Potential Impacts of Plug-In Hybrid Electric Vehicles on Energy and Emissions Using One-Day Travel Data," by W. W. Recker, J.E. Kang, which can be found at www.uctc.net/research/papers/UCTC-FR-2010-14.pdf.