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Electricity as Transportation "Fuel"

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The personal automobile is a surprisingly efficient device, but its place in a sustainable transportation future hinges on its ability use a sustainable fuel. While electricity is widely expected to be such a "fuel," the viability of electric vehicles rests on the validity of three assumptions. First, that the emissions from generation will be significantly lower than those from competing chemical fuels whether 'renewable' or fossil. Second, that advances in battery technology will deliver adequate range and durability at an affordable cost. Third, that most customers will accept any functional limitations intrinsic to electrochemical energy storage. While the first two are subjects of active research and vigorous policy debate, the third is treated virtually as a given. Popular statements to the effect that "because 70% of all daily travel is accomplished in less than 100 miles, mass deployment of 100 mile EVs will electrify 70% of all travel" are based on collections of one-day travel reports such as the National Household Travel Survey, and so effectively ignore the complexities of individual needs. We have analyzed the day-to-day variations of individual vehicle usage in multiple regions and draw very different conclusions. Most significant is that limited EV range results in a level of inconvenience that is likely to be unacceptable to the vast majority of vehicle owners, and for those who would accept that inconvenience, battery costs must be absurdly low to achieve any economic payback. In contrast, the plug-in hybrid (PHEV) does not suffer range limitations and delivers economic payback for most users at realistic battery costs. More importantly, these findings appear to be universal in developed nations, with labor market population density being a powerful predictor of personal vehicle usage. This "scalable city" hypothesis may prove to a powerful predictor of the evolution of transportation in the large cities of the developing world.