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Electric Vehicles May Be Using Less Electricity than Assumed by California Regulators and Utilities

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Issue

The widespread adoption of electric vehicles (EV) is a centerpiece of California's strategy to reach net-zero carbon emissions, but it is not fully known how and where EVs are being used, and how and where they are being charged. California is home to approximately half of the EVs in the United States, yet policymakers attempting to guide transportation electrification lack rigorous estimates of how much electricity EVs are actually using because the majority of EV charging occurs at home, where it is difficult to distinguish from other household uses recorded on the electricity meter.

To provide policymakers more accurate data, we developed the first at-scale estimate of EV home charging. Previous estimates were based on conflicting surveys or extrapolated from a small, unrepresentative sample of households with dedicated EV meters. We combined billions of hourly electricity meter measurements with address-level EV registration records from California households, including roughly 40,000 EV owners.

Key Research Findings

EV home charging is less than half of what policymakers have assumed. California regulators have relied on residential charging data reported by electric utilities for households with dedicated EV meters, estimating a daily average usage between 6 and 9.8 kWh per day. In contrast, matching California Department of Motor Vehicles registration records with a random sample of

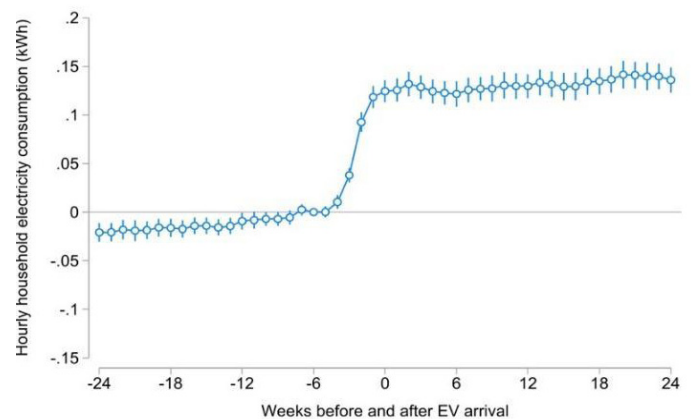


Figure 1. Increase in Hourly Electricity Consumption in Weeks After Arrival of an EV

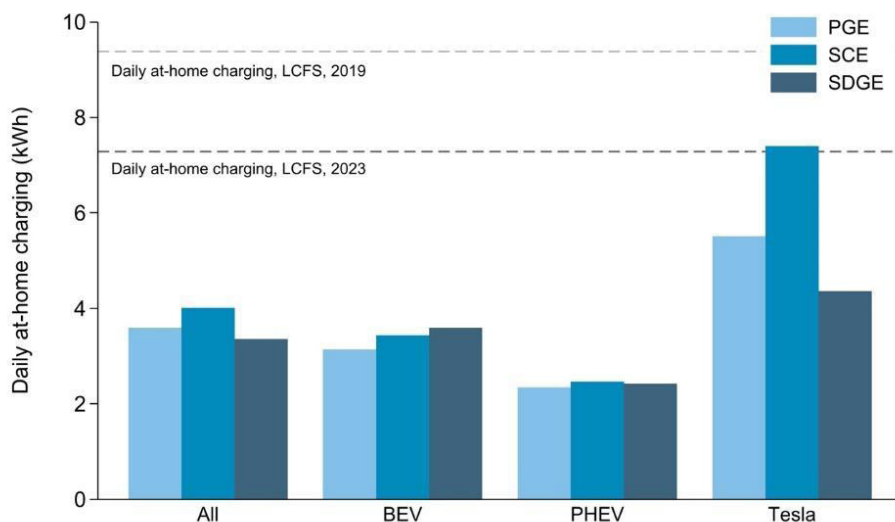


Figure 2. Estimates of Home Charging by Utility and Vehicle Type

electricity consumption data from the three major investor-owned electric utilities (PG&E, SCE, and SDG&E) between 2014 and 2019 indicates that adopting an EV increased household electricity consumption by only 3.7 kWh per day (See Figure 1). Starting in 2023, the California Air Resources Board updated its methods for calculating residential EV charging, relying more on self-reported data taken from vehicle telematics, resulting in reduced averages that are closer to our estimates.

The amount of home charging varies significantly between vehicle types. Electricity usage increased only a modest amount in homes with a plug-in hybrid (PHEV), while homes with a Tesla increased consumption by roughly 6.2 kWh per day, more than any other EV manufacturer. See Figure 2. Although battery electric vehicles in general consume more electricity than PHEVs, California’s Low Carbon

Fuel Standard regulatory program awards the same amount of credits for all registered EVs.

Home charging is significantly lower for low-income households. Electricity consumption increased about 20 percent less at households enrolled in California’s low-income electricity (CARE) rates than in households not enrolled in these rates. Most of this difference can be attributed to the types of EVs typically registered at CARE households where, for example, Teslas were less common.

More Information

This policy brief is drawn from the report “Estimating Electric Vehicle Electricity Use” available at www.ucits.org/research-project/2021-30. For more information, please contact James Bushnell at jbbushnell@ucdavis.edu.

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