HomeSHIFT: Automated Coordination of Home Distributed Energy Resources for Minimizing Personal Energy Carbon Footprint Anusha Narayan

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This paper introduces HomeSHIFT, a framework designed to minimize personal energy carbon footprints through easily implementable algorithms for household energy management. HomeSHIFT leverages continuous monitoring of grid carbon intensity, which fluctuates based on the availability of renewable energy sources such as wind and solar. During periods of high wind and solar generation, grid CO2 emissions are lower, while reliance on fossil fuels during other times results in higher emissions. Using grid carbon intensity data from CAISO and household energy data from utility smart meters, high-emission periods—particularly evening ramps—were identified.

HomeSHIFT optimizes battery discharge and EV charging schedules within the same time-of-use windows, aligning energy use with periods of lower grid intensity. The system operates seamlessly in the background, requiring no behavioral changes from the consumer, making it highly scalable and user-friendly. Under the Pacific Gas & Electric Time-of-Use tariff in Northern California, the high-price period runs from 4 PM to 10 PM on weekdays. Standard settings in the Tesla Powerwall application discharge the battery at maximum power starting at 4 PM, depleting it within two hours. Consequently, from 6 PM onward, the household must rely on grid electricity, often during peak carbon intensity. HomeSHIFT shifted the battery discharge to 7–9 PM, reducing grid carbon intensity by 46% compared to the 4–6 PM window.

By prioritizing clean energy use and reducing consumption during high-intensity periods, HomeSHIFT offers a scalable and practical method for cutting household carbon emissions through small programming changes. These adjustments can be seamlessly integrated into existing applications without requiring consumer behavioral shifts. Scaling HomeSHIFT across all batteries, electric cars, and homes holds the potential to reduce millions of tons of emissions globally.