Unintended Consequences of Time-of-Use Rates: EV Charging and Distribution Network Constraints*

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Abstract

We implement a field experiment to assess the effect of time-of-use (TOU) pricing and managed charging to shift the timing of electric vehicle (EV) charging and reduce strain on the electric distribution grid. We randomly assign EVs into 10-vehicle "virtual transformer" groups that face randomized, daily transformer constraints. We find that TOU pricing shifts EV charging activity to low-priced hours of the day, but induces a "shadow peak" of simultaneous charging activity at the start of the low-priced TOU period. This unintended coordination aspect of TOU pricing increases the frequency of virtual distribution transformer constraint violations compared to our control group. In contrast, centrally managed charging of EVs reduces the frequency of virtual transformer constraint violations compared to our control group.

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