

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

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Starting Point

- Any grid infrastructure optimally depends on the variance in individual peak demand interacted with the extent to which it correlates with the peak demand of others
- The former does and the latter could theoretically increase with more electric vehicles (EVs)
- Correlation of EV charging even more an issue at the disaggregated level

→ Potentially increased strain on grid infrastructure due to EVs especially at the local level

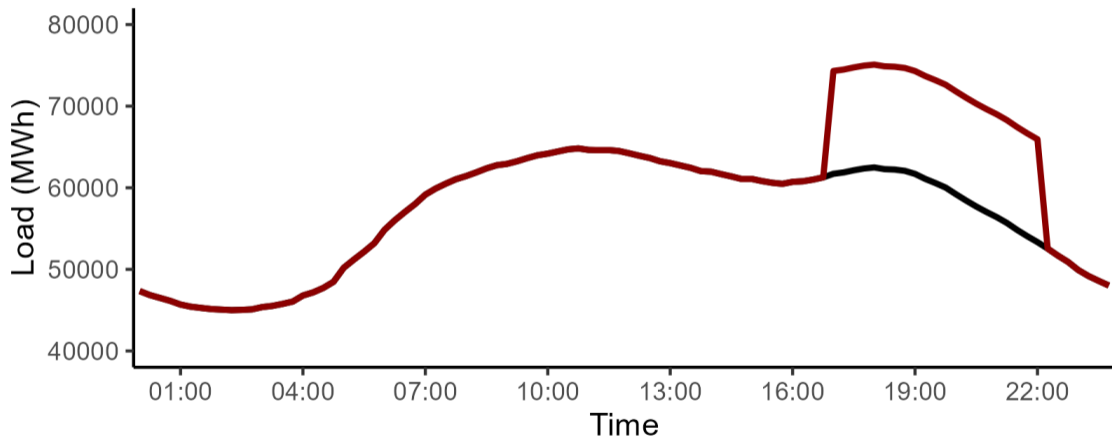
Research Question

- **Question:** Given that local grids cannot be easily/quickly expanded, how can load from home charging of EVs be spread throughout the day to decrease investment need into grid?
- Design a field experiment randomly assigning households that charge at home to control and treatment with either Time-of-Use (TOU) rates or managed charging → Great data!

Contribution

- Show that TOU rates lead to a new peak load at the beginning of the evening off-peak hours
- So standard TOU rates do not work: The goals of minimizing generation costs and reducing strain on local grids do not perfectly align at lower levels of EV penetration
- Giving more competence to grid operators can alleviate this problem
- If TOU effect holds up for higher levels of EV penetration, then might have adverse effect on generation cost → Load timing more coordinated also in the aggregate?

Aggregate load if all charging was done at 5pm



Comments

Does the extensive margin matter?

- There are lower prices for home charging vs. charging elsewhere in both treatment groups → Do we see more home charging in total?
- If no, then this might indicate that public charging is strictly necessary
- If yes, then maybe necessary to control for it in diff-in-diff otherwise it captures both timing and extensive margin effects

Comments

”Surprisingly” low opt-out of managed charging?

- Setting potentially allows to ex-post evaluate other management algorithms?
- Test e.g. same algorithm but only applied for the night → Maybe more accepted

Changing effects with more market maturity?

- Given the randomization of the RCT we do not cluster together EVs that actually are on the same transformer → location sorting might affect treatment effects found?
- With technological advance (level 3 charging e.g.) the TOU effect is even more pronounced? → Motivation to push for fast public charging instead of home charging due to diverse driving times