

Digital Dispatch and Demand Response in Grid Emergencies: Evidence from Household Cooling in California's Flex Alerts



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Introduction

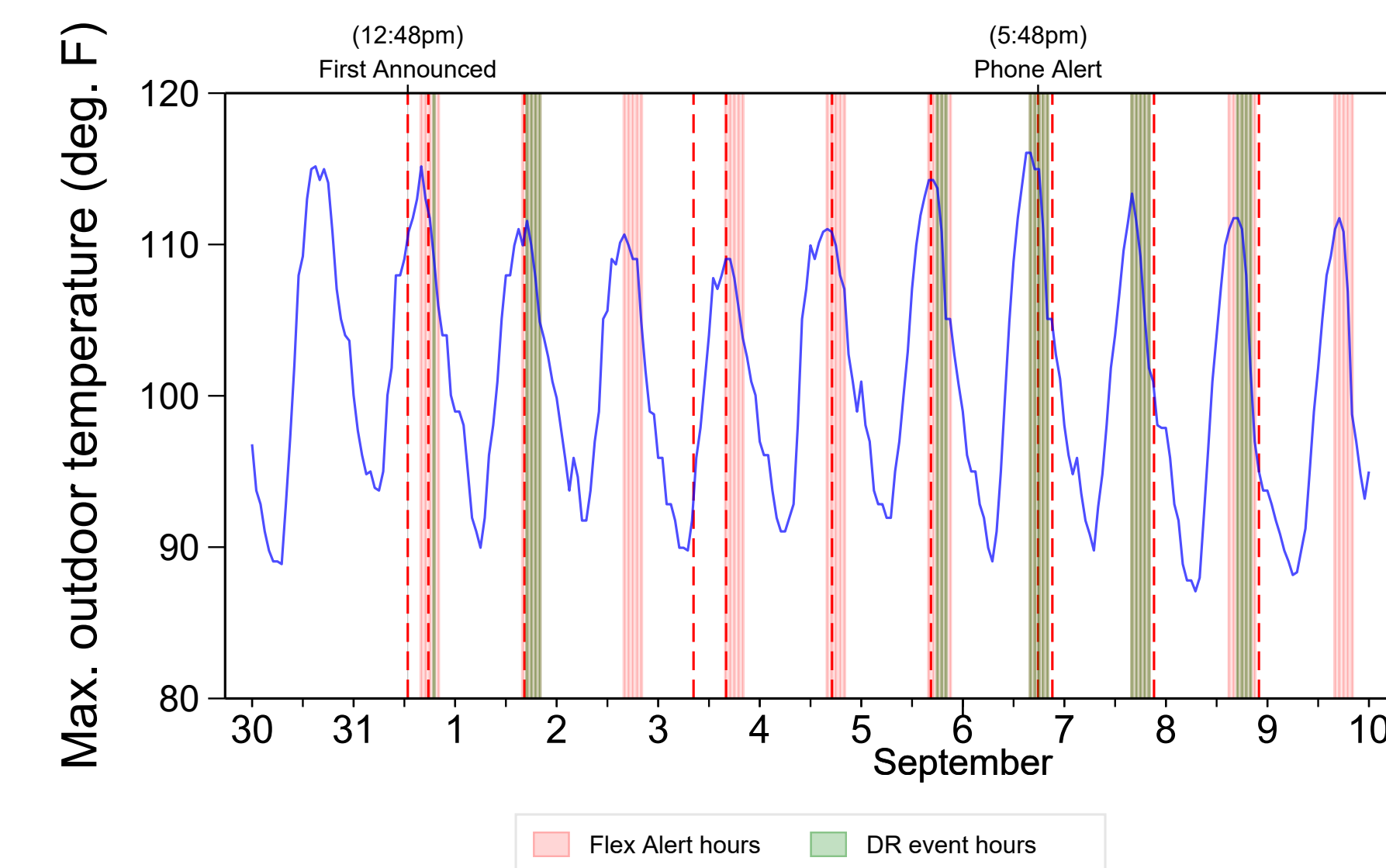
Climate scientists predict that the risk of extreme heat will increase, causing more frequent and intense peak electricity demand across the United States (Auffhammer et al., 2017). Recent work in economics has studied critical peak pricing and other demand-side incentives to ensure conservation when electricity is scarce (Allcott and Rogers, 2014; Blonz et al., 2025; Brandon et al., 2019; Ito et al., 2018; Prest, 2020), but during emergencies, grid operators still regularly resort to voluntary appeals for conservation, with varied success (Brewer and Crozier, 2023; Holladay et al., 2015). We study the natural experiment created by ten consecutive Flex Alert days during an extreme heat wave from August 31st to September 9th, 2022.

Research Question

1. How do households' cooling behavior respond?
2. How effective were these in reducing electricity demand, and what are the welfare consequences?

Data and Empirical Strategy (cont.)

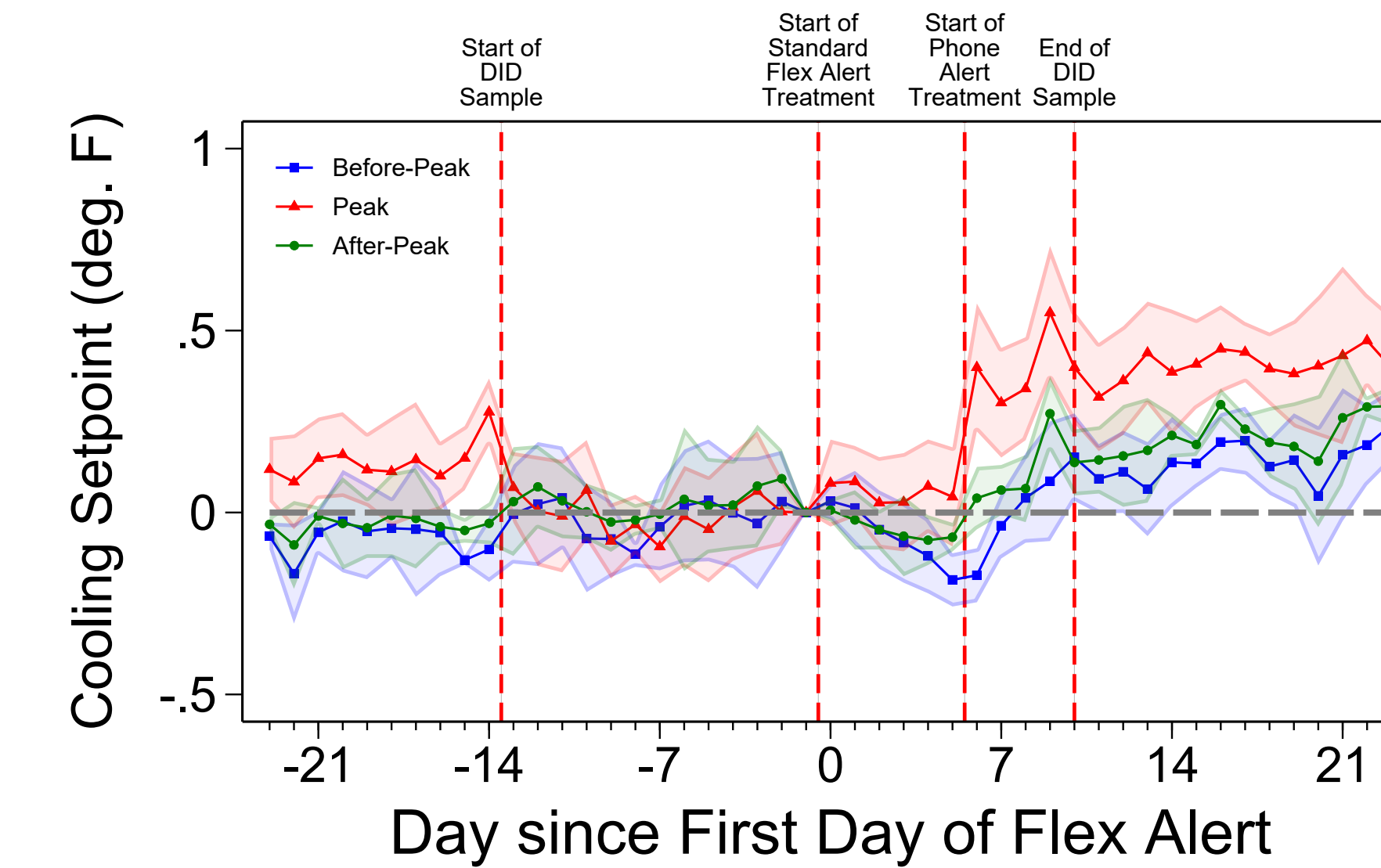
We leverage quasi-experimental variation in **timing of Flex Alerts and DR events** and employ a **difference-in-difference research design** to estimate the effect of Flex Alerts and DR events under low and high salience on cooling behavior.



We control for weather covariates, hour-of-sample FEs, and household-by-hour-by-day-of-week FEs.

(Dis)habitation and Hysteresis

We perform an event study to look at how cooling behavior evolves in consecutive Flex Alerts:



- Households habituate to repeated Flex Alerts,
- The phone alert creates a dishabituation effect, where household responses increase subsequently,
- Higher setpoint persists beyond Flex Alerts.

Discussion and Conclusion

We study California's Flex Alerts and find:

- Standard Flex Alerts are not a salient nudge, elevating salience via phone alert is crucial
- Moral suasion + automated demand response is more effective on an individual basis
- New evidence on habituation, dishabituation, and hysteresis in cooling behavior

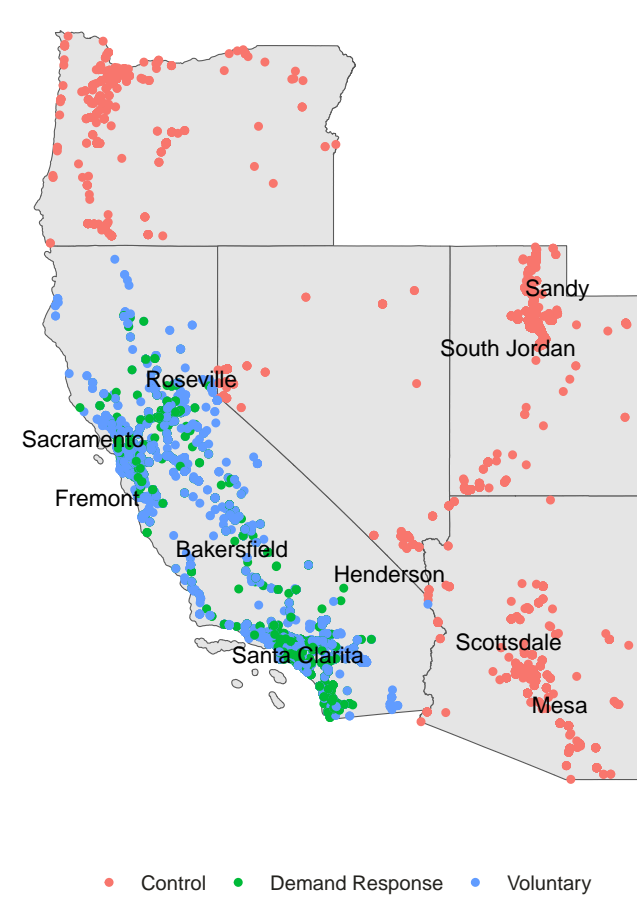
We develop a framework to evaluate the welfare effect of emergency conservation requests and show:

- Voluntary conservation contributes 90% of electricity demand reduction
- The September 2022 Flex Alerts results in \$69.8M total welfare gain

Our study offers insights into the design of effective conservation efforts in grid emergencies

- Incentives for pushing DR program enrollment and/or smart technology adoption
- Voluntary requests will continue if no DR program or supply-side improvement

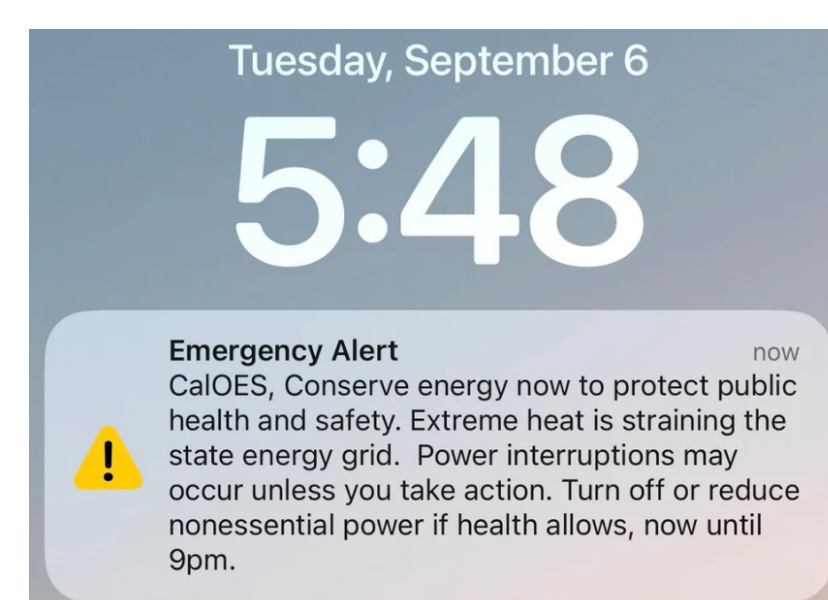
Data and Empirical Strategy



Treatment group:
CA
5,180 non-DR
3,319 DR

Control group:
NV, AZ, OR, UT
3,706 non-DR

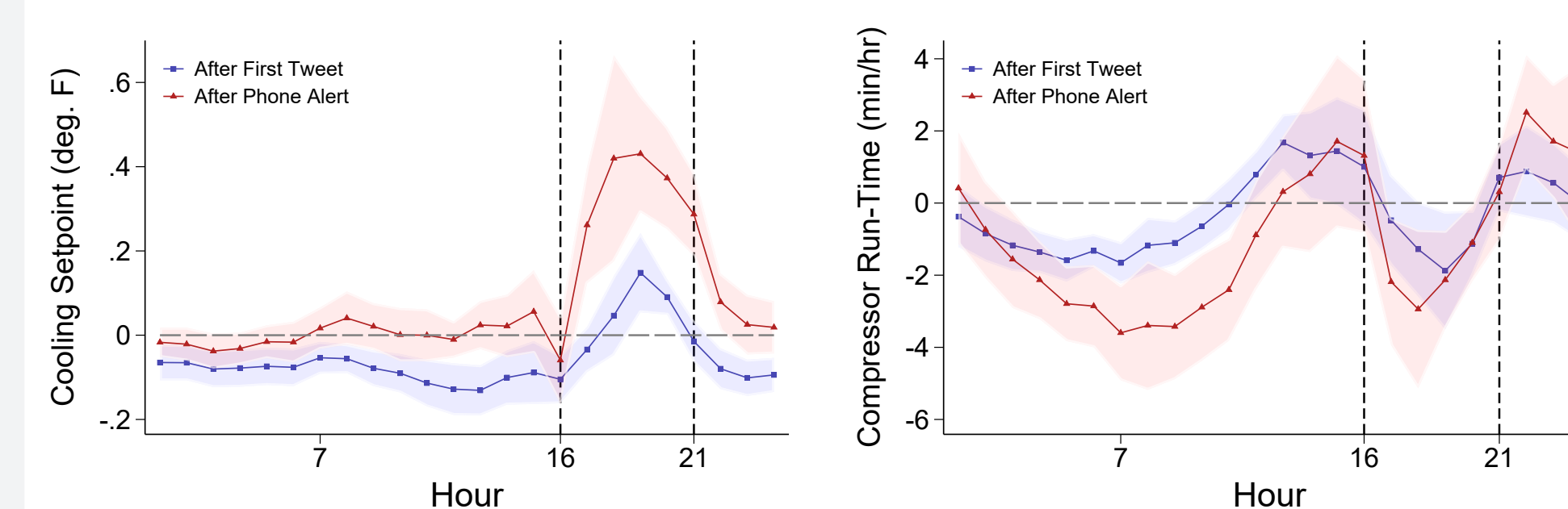
We observe **cooling setpoint** and **AC usage** from households with **Ecobee Smart Thermostat**



California received repeated Flex Alerts with increased salience due to the phone alert.

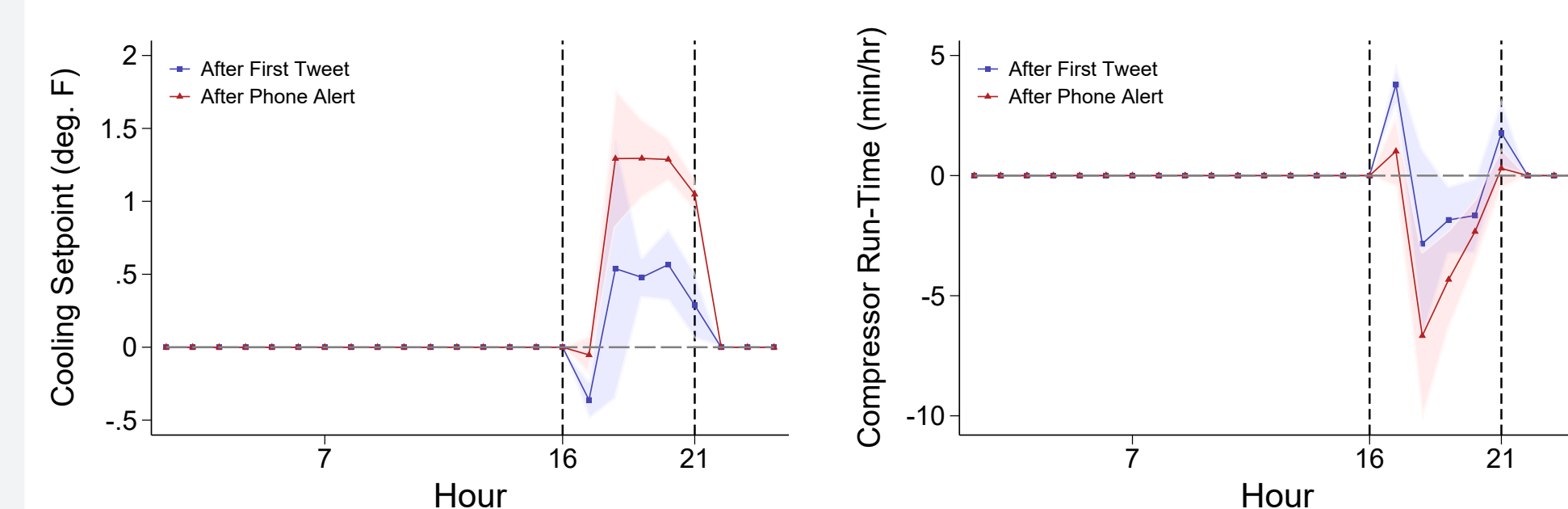
Estimation Results

Responses to Flex Alerts



- Standard Flex Alerts are not a salient
- Households only respond after the phone alert

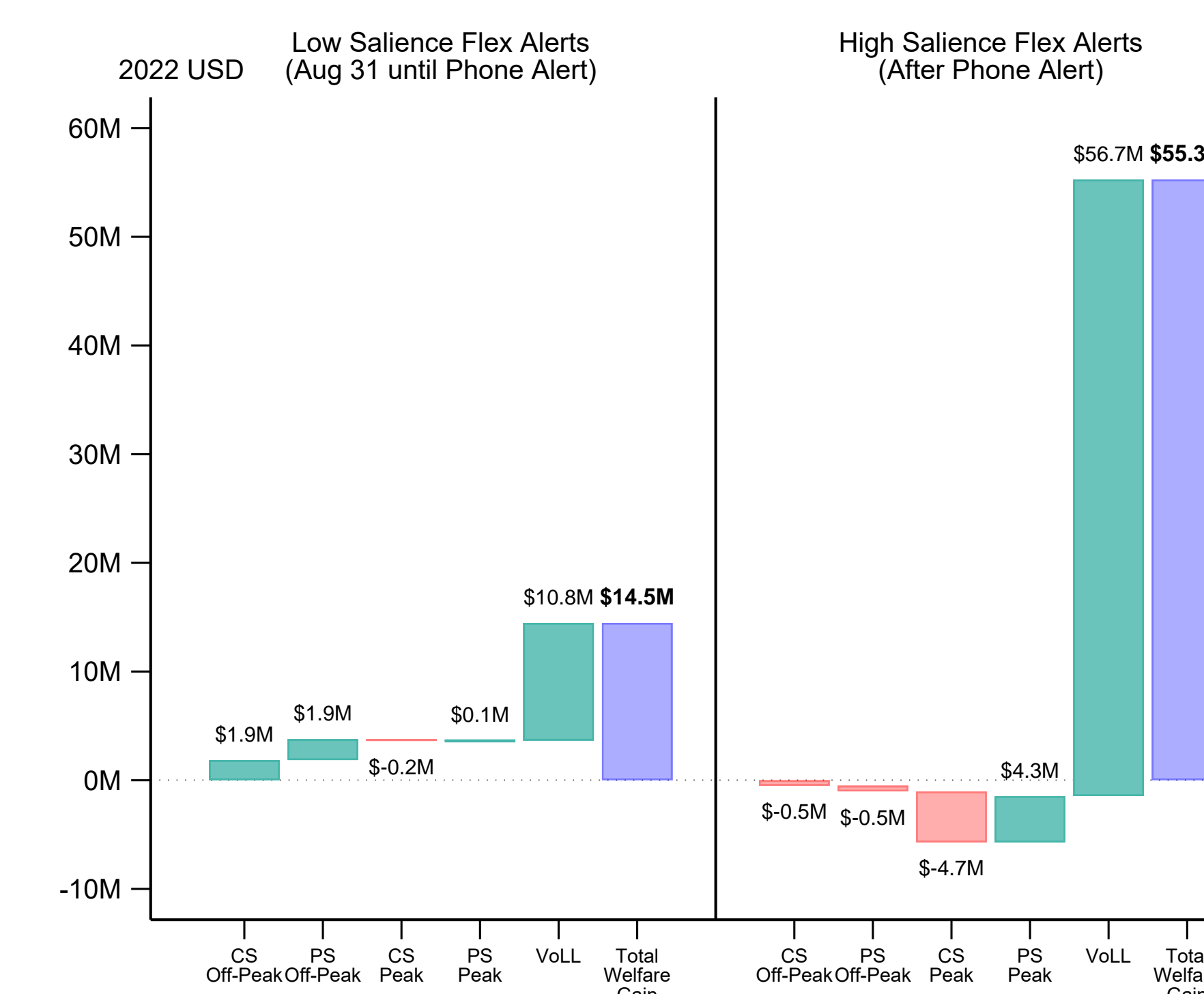
Responses to DR Events



- Increased salience caused 3x higher response
- Automated DR is more effective than Flex Alerts

Welfare Implication

Using our empirical estimates with a set of assumptions on household cooling technology and demand response enrollment, we perform welfare simulation.



- Demand reduction up to 800 MW in standard Flex Alerts, and up to 1,300 MW after the phone alert,
- Estimated net welfare gains of \$69.8 million.

References and Disclaimer

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