OPTIMIZING THERMOSTAT DR PROGRAM PERFORMANCE:
Blending Qualitative and Quantitative Research to Understand Customer Behavior

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DEMAND RESPONSE (DR) PARTICIPATION & WEATHER
STUDY PURPOSE

WEATHER AND DR PARTICIPANT BEHAVIOR

This study does not estimate thermostat or DR savings—it's purpose is to better understand how DR program participants may react to weather and program design elements.

How do heat and humidity affect propensity to opt-out of events? How do program design elements affect DR participant behavior? Can participants be classified by “type” in a meaningful way?
STUDY AREA

WORCESTER, MA

- Roughly 185,000 people
- Hot, humid summers from June to September
- Most houses built before the 1980s
METHODS

QUANTITATIVE APPROACH
Telemetry data from 6,000 programmable thermostats enrolled in Thermostat DR Project during the summers of 2016 and 2017

- Linear probability model regression
- Sub-hourly thermostat and weather data

QUALITATIVE APPROACH
3 interviews with DR service providers (DRSP)
20 interviews with DR program participants

- 12 in the Thermostat DR Project
- 8 in the Opt-out Dynamic Pricing Pilot
CHARLIE | COMFORT SEEKER
“I don’t base everything on the events…certainly my comfort is going to come before an event.”

BERNADETTE | BESTEFFORT
“When I know an event is coming…maybe I take the kids somewhere to be out of the house.”

RALPH | RELIABLE
“If I get too hot [during an event], I almost turn it on…[but] it’s basically the end of the event [so I leave it].”
Participants across program types had common motivations to enroll in their programs.

**Motivations to participate:**
Free or reduced-price thermostat or an incentive
Save money and see evidence of savings
Help their utility and the “greater good”

“The reason why I signed up is I would like the smart thermostat to actually try to help me save energy... Say we go out for the day, and if it gets too hot for the dogs, we're able to turn on the AC for them without having to go home.”
– Ralph, The Reliable Participant
PROGRAM DESIGN & EDUCATION

Program design and customer education may help decrease opt-outs.

Event participation thresholds for the incentive led to lower opt-out rates. Many still prioritized comfort over event participation due to the relatively low incentive amount.

Customer engagement and education may decrease opt-outs. Customers do not fully understand the program’s purpose or what to expect. Engaged customers may feel more invested in the program and be less likely to opt out.

Because they do pre-cooling, I’m not saving money, which I thought that I would be...prior to the event they pre-cool, which kind of defeats the purpose.
– Bernadette, The Best-Effort Participant
Heat and humidity in the moment increase opt-outs.

Interviewed participants do not plan to opt out, and humidity plays a key role in their decision. Opt-out decisions are made in the moment based on comfort. They felt less able to cope with humidity than heat.

Heat and humidity cause statistically significantly higher opt-outs. Higher heat the previous day decreases opt-outs. A day that is 3.7º F hotter increases opt-out likelihood by nearly 3%. Opt-out likelihood increases nearly 1% given a 17% higher maximum relative humidity.

“On hot, humid days, [the event] was from 12 p.m. to 7 p.m. You get home at 5 p.m. and the last thing you want is to come into a steaming house…that’s when I opted out.”
– Charlie, The Comfort Seeker
**Event Timing and Total Event Duration Impact Opt-outs.**

Event duration and day-of-week significantly affect opt-outs.

Events that lasted later into the evening led to more opt-outs.

Late events made balancing energy use with household’s needs difficult.

Opt-outs increase linearly throughout an event.

May reflect heterogeneous comfort preferences or home arrival times by household.

“*If we go to bed and the house is still really hot and humid, that’s really hard because we only had since 8 p.m. to 9 p.m. to cool it down…we can’t get it cool enough to sleep comfortably.*”

– Bernadette, The Best-Effort Participant
Back-to-back events could lead to program fatigue, frustration, and opt-outs.

Quantitative and qualitative results diverge.
Back-to-back events were found to have no statistically significant effect on opt-outs. Interviewed participants expect to feel back-to-back event fatigue.

Possible explanations:
Perceived behavior may not align with actual behavior.
Two consecutive days may not be the critical back-to-back threshold.

“If it happens a lot, I think it would become more frustrating...you’d be like, ‘I’m not comfortable. I’m not comfortable every day in my house.’ At that point, you’re going to be, like, ‘No. I don’t want do that.’”  
– Ralph, The Reliable Participant
CONCLUSIONS

Role of Weather and Event Parameters in Opt-Out Behavior

Understanding behaviors of different customer types can help optimize program performance and make messaging cost-effective.

Consider weather and event characteristics to optimize program savings and customer satisfaction, while minimizing opt-outs.

Consider technologies and behavioral strategies, like gamification, that deter customers from opting out, in addition to appropriately designing incentive structures.
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