

NAVIGANT

ILLUME



# 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**

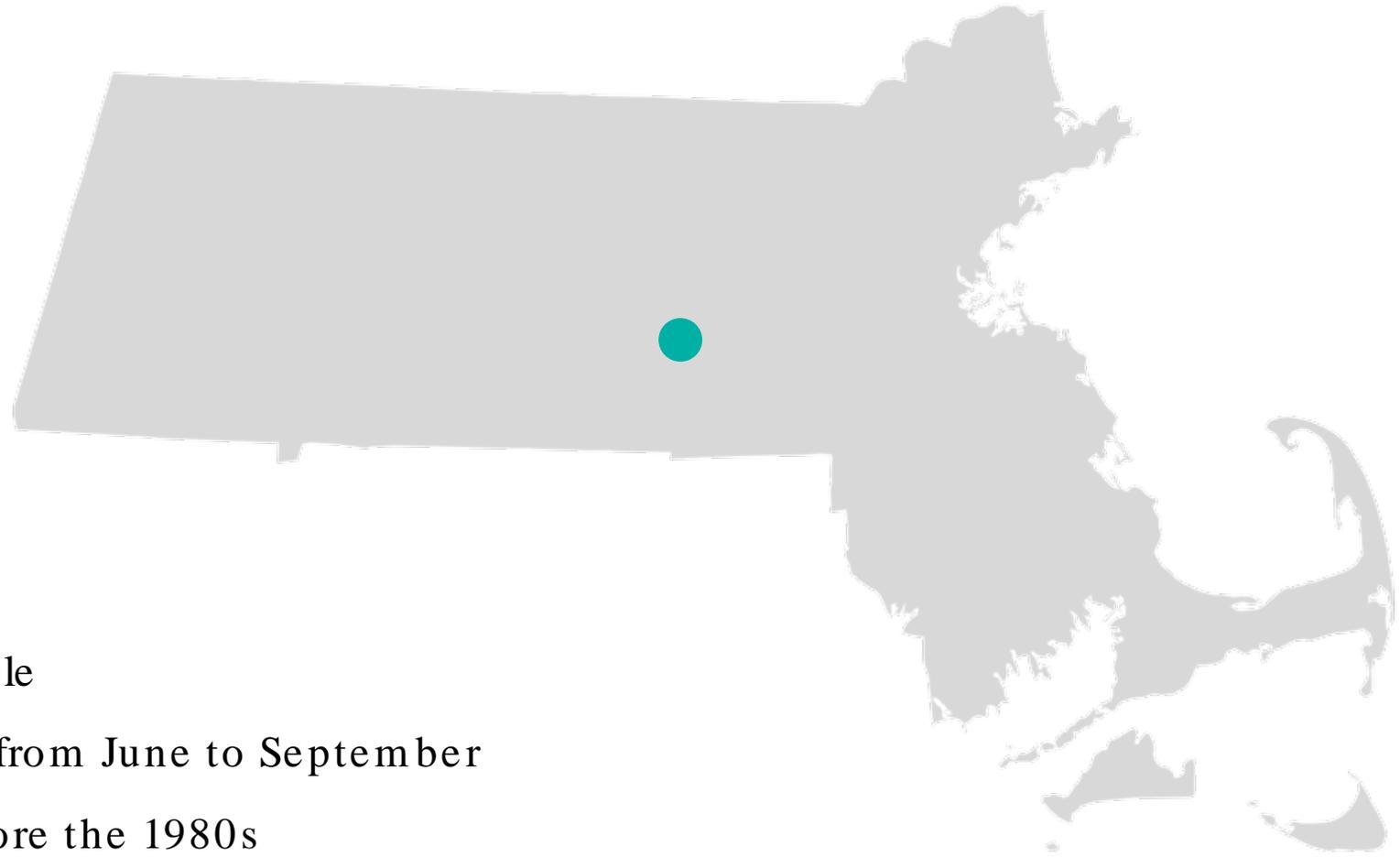
This study does not estimate thermostat or DR savings—its purpose is to better understand how DR program participants may react to weather and program design elements.

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

# PROFILES



**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]."*

# MOTIVATIONS TO PARTICIPATE

*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 & HUMIDITY

*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 3.7° 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 DURATION & TIMING

*Event timing and total event duration impact opt -outs.*

**Event duration and day -of-week significantly effect opt -outs.**

Every hour of additional event duration increases likelihood of opt-out by over 3%.

Opt-out propensity increased by nearly 4% on Thursdays and Fridays relative to Wednesday.

**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

# EVENT FREQUENCY & FATIGUE

*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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