Molly Podolefsky, Navigant

Presentation Title: Optimizing Thermostat DR Program Performance - Blending Quantitative and Qualitative Research to Understand Customer Behavior

Abstract: Thermostat-based demand response (DR) programs comprise a growing share of large-scale residential DR programs across the country. A recent Smart Electric Power Alliance (SEPA) survey found 49 utilities had thermostat DR programs and 21 utilities either offered thermostat DR pilots or were planning to implement them. Unlike decades-old air conditioner switch-based programs, modern thermostats give customers more control over their participation in DR, enabling customers to opt-out or override settings for DR events. One of the confounding issues for evaluation is trying to separate out the demand and energy saved from what would have occurred absent the program interventions. Our ability to do this type of calculation is hampered by the lack of data on how households current use their cooling equipment during summer periods; most specifically what is the relationship between extreme weather use and thermostat control behavior. Parallel research conducted by us shows that most users do not let the thermostat automatically control their cooling systems. Most households frequently manually adjust their thermostat settings. This factor greatly complicates the measurement of DR savings. For thermostat-based DR to be a reliable resource in a future distributed energy resource world, programs need to reward DR that represents a true program-induced behavior--and that means we need studies that illuminate how people use modern thermostats in response to weather and comfort preferences during DR events to optimize participation and program impacts.

We have concluded a cutting-edge study in Massachusetts during 2018 investigating exactly this--how customers react to weather and use their thermostats during DR events, in order to inform optimal program design and implementation. Performing regression analysis using thermostat telemetry data from nearly 6,000 devices during the summers of 2016 and 2017, and combining this with in-depth interviews with 3 DR service providers and 20 DR participants, we blended quantitative and qualitative approaches to understand people's behavior during DR events. We combined data describing the event (i.e., event duration, event start time, length of time between events) and customer thermostat use (i.e., cooling setpoint, cooling status, indoor temperature at quarter-hourly intervals) with quarter-hourly, ZIP-code level weather data, including temperature, relative humidity, HBU, and temperature-humidity index to estimate precise effects of weather and event parameters on opt-out behavior, and drew upon the insights from our in-depth interviews to validate and further explore causal channels for estimated effects.

This study provides rich insights for us to share on how weather affects opt-out behavior, customers' experience of event fatigue from back-to-back events or event duration, the extent to which customers react to weather and comfort concerns in the moment versus over longer periods, and tactics such as messaging, competitions, gamification and program parameter adjustments the utility can use to mitigate opt-out behavior and optimize savings. Thermostat DR programs may play an increasingly large role in the energy landscape moving forward, and utilities and implementers will take away actionable insights from this presentation moving their thermostat DR programs in the right direction.