nest

Rush Hour Rewards

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Introduction

With more than 5 million load control devices installed across the United States, residential demand response (DR) has come a long way. Today, a variety of internet-connected "smart" thermostats are making residential DR programs more user-friendly and cost-effective. More than that, these new device alternatives are helping energy providers accomplish goals beyond peak load management, driving overall energy efficiency and customer satisfaction.

Nevertheless, important questions remain about *how* smart thermostats should be deployed in DR programs to be most successful. Having partnered in the deployment of numerous thermostat DR programs with leading energy providers, we've developed a clearer picture of what customers actually care about and why. This paper is designed to share our insights into:

- The best practices to get customers enrolled
- The keys to driving greater customer satisfaction year after year
- The circumstances that should steer energy providers to specific program designs

Is there a better way to deliver residential DR?

For decades residential demand response has been done the same way, and has been largely successful. Energy providers have paid to install load control devices (mostly one-way paging switches and thermostats) in people's homes, enrolling millions of participating customers and delivering thousands of MWs of peak load management. But while they deliver load reduction during demand response events, these devices have significant limitations.

The first set of limitations are operational:

- Because one-way communicating devices can only receive a signal from the utility—they do not communicate back—they provide utilities with no visibility into the true load available at any given moment.
- Load control programs degrade over time due to device malfunction, removal, or disconnection.
- Finally, load control switches can only manage AC consumption, limiting load control to the summer months.

Second, load control programs incur high implementation costs without offering energy providers much in the way of ongoing customer engagement. In fact, load control switches have never provided much value for the consumer, save for enabling them to participate in load control programs. Older DR-connected thermostats may have some additional value beyond peak management, but still not enough for most customers to feel any impulse to purchase them off the shelf. For that reason, energy providers rolling out these types of DR programs often have had to offer generous incentives and engage in expensive marketing campaigns. Moreover, once they've identified a willing participant, they have to purchase the hardware and incur the cost of installation.

Noting these limitations, we at Nest began to wonder whether connected thermostats like the Nest Learning Thermostat could enable a higher-value approach to residential DR. Our first step was to ask a series of questions. What if we could embed demand response into an existing consumer product that's *already* popular among utility consumers and that many consumers have already purchased and installed? What if we could use software and analytics to shift more load during DR events while keeping customers comfortable? What if we could create programs that not only delivered load consistently and reliably, but also strengthened an energy provider's relationship with its customers? And what if we could do all of this while helping customers save energy year-round?

Enter Rush Hour Rewards

In developing our own thermostat DR program, we aimed to create a solution that not only delivers real value to customers, but one that *customers really like*—a demand response program that they would seek out, mention to friends, share on social media, and participate in year after year. Our objective was to use algorithms and machine learning to implement residential DR in a much more intelligent manner—unlike traditional AC cycling or temperature setback strategies that use a single, one-size-fits-all solution for managing customer load, Nest is able to deploy an individual setpoint optimization tailored to the specific home on the specific day that balances customer comfort and AC consumption.

> *"A solution that not only delivers real value to customers, but one that customers really like."*

So in the spring of 2013, we launched our new offering, branded as Rush Hour Rewards (RHR), with three enterprising energy partners. In the past several years, Nest has successfully launched Rush Hour Rewards programs with 18 energy partners in the U.S. and Canada, including:

- Investor-owned utilities
- Municipal utilities
- Competitive energy retailers
- Member-owned cooperatives

In a few short years, RHR has reached meaningful scale, enabling us to take stock of its impact. Here's what we've found:

LOAD REDUCTION: In 2015, Rush Hour Rewards on average achieved around 55% aggregate HVAC load reduction* during events.

ENERGY EFFICIENCY: For utilities with energy efficiency goals, smart thermostats deployed in demand response programs can also provide significant benefits. Studies of the Nest Learning Thermostat indicate that US customers save about 10–12% on their heating bills and about 15% on their cooling bills,** above and beyond the capacity savings provided during DR events.

CUSTOMER SATISFACTION: In 2015 we found that 56% of respondents to our end-of-season survey reported feeling more satisfied with their energy provider after participating in their Rush Hour Rewards program, while only 4% felt less satisfied. Some of our partners saw satisfaction grow among nearly three quarters of respondents.

Along the way, we've learned a lot. Comparing and contrasting our different partnerships has yielded real, practical insights. We want to share this knowledge.

How do you get customers in the door?

Millions of customers have purchased smart thermostats. Millions are online. However, these devices continue to be an underutilized resource for demand response. How can we convert this large and growing population of customers into demand response participants? Our years working on this challenge suggest that customer enrollment keys on three crucial ingredients:

1. The program's rewards must be *simple* and *compelling*.
2. The message the customer receives must be *tailored* to the customer's specific motivations.
3. The customer must *understand* what they are signing up for.

WHAT WE'VE LEARNED #1:

Customers need to feel the reward up front.

In many cases, getting customers to sign up in the first place is a much bigger hurdle than keeping them engaged. And to get customers to sign up, you need to make them *feel rewarded*.

Here's the bottom line: we've seen the highest adoption rates in programs that give customers a meaningful up-front incentive payment at the time of enrollment. Providing enrollment rewards feels immediate, and tangible—and that's why they work.

How you pay customers matters as well. The more visible, the better. Our experience suggests that direct payments—such as checks—are best. Bill credits are a challenge given how little attention most customers pay to the details of their bill—the risk is high that the customer doesn't notice the reward.

> *"Providing enrollment rewards feels immediate, and tangible—and that's why they work."*

WHAT WE'VE LEARNED #2:

Market to multiple motivations.

When we first launched Rush Hour Rewards, we assumed that the best way to get customers enrolled in a DR program was to jazz up the reward itself. Money talks. But we've discovered that our presumption was too simplistic. Much as everyone likes to earn money, customers are frequently motivated by other desires.

*Reduction as compared to a Nest-estimated baseline, which is derived from observing historical HVAC performance in relation to indoor and outdoor temperatures. Load is measured as a percentage of time an HVAC system is actively running .

**Nest Labs, Energy Savings from the Nest Learning Thermostat: Energy Bill Analysis Results. Feb. 2015. <https://nest.com/downloads/press/documents/energy-savings-white-paper.pdf>

How do we know? At the end of the 2015 summer season, we asked participants across our various programs: "What is the primary reason you enrolled in the Rush Hour Rewards program?" A slightly greater proportion (44%, combined) were driven either to "use less energy" (33%) or "help [the] environment" (11%). If environmentally focused consumers understand that Rush Hour Rewards could make it less likely that an energy provider will turn on an inefficient power plant, they're much more likely to enroll.

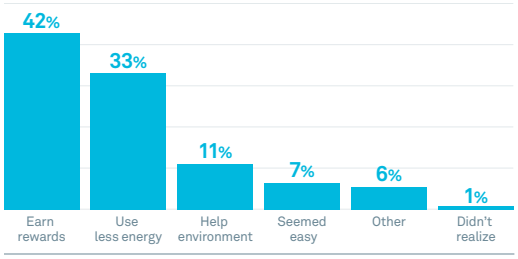

Figure 1.

That points to a core issue for anyone hoping to enroll more customers: Who should you target, and with what message? Interestingly enough, income and home size do *not* correlate in any significant way with any single motivation. But age does. Participants over the age of 55 are 2 times more likely to list their primary motivation as energy/environmental, while participants between the ages of 18 and 34 favored rewards 40% more often than those 35 or older.

WHAT WE'VE LEARNED #3:

There's a lot in a name.

Most people rarely think about their energy consumption. For that reason, simple things—like what a program is named—can have a huge impact on whether they enroll. Names need to be friendly, direct, and help customers to understand the concept of demand response. That's why we chose to name our DR offering "Rush Hour Rewards."

Everyone's driven on a clogged highway at one point or another. And it's easy enough to apply the same concept to peak load management. "Just as traffic clogs up roads when everyone drives to work at the same time," we explain to customers, "energy rush hours occur when everyone in a particular area turns on air conditioning or heating at once."

Then we explain why it's so important to address: "Imagine what can happen when millions of people turn on their air conditioners during a heat wave. Layered on top of the typical demands made by running refrigerators, TVs, lights, and computers, rush hours put a tremendous strain on the grid." Naming the program "Rush Hour Rewards" provides customers a foundation to understand *why* they should embrace the new technology—and the concept implicitly explains *how* it works.

How do you keep the customer satisfied?

Once you've got your customer enrolled, the challenge shifts to keeping customers satisfied and engaged so that you achieve load reduction and customer satisfaction benefits not just over one season, but for many years. A survey conducted at the end of the 2015 summer season explored the key ingredients for program satisfaction. Customers were asked to rate their overall satisfaction with their Rush Hour Rewards program (on a scale from 1 to 10) and then to rate (on a scale from 1 to 5) their satisfaction with 6 different aspects of the program.

WHAT WE'VE LEARNED #1:

Focus on what matters—rewards and comfort.

Some of this isn't rocket science. As you might expect, when customers are satisfied with their rewards, they're very likely to be satisfied with the program. Similarly, comfort in the home tends to correlate with program satisfaction, and customer comfort in turn correlates with both the length and the number of rush hours. But there are important wrinkles. It turns out that the difficulty customers have when enrolling trickles down into their overall satisfaction. Those who enrolled with ease were much more likely to be happy a year later.

	Relationship with Program Satisfaction (Pearson r)
Notifications	Weak (.27)
Program Enrollment Process	Moderate (.36)
Number of Rush Hours	Moderate (.46)
Length of Each Rush Hour	Moderate (.48)
Household Comfort	Moderate (.47)
Rewards	Strong (.5)

Figure 2.

WHAT WE'VE LEARNED #2:

The way you reward customers after they've enrolled is more powerful than the size of the reward itself.

Rewards may drive a certain amount of customer satisfaction—but the *amount* of any given reward

is less important than the *manner* in which you deliver it. So what's a utility to do? Energy providers have the option to only pay customers up-front or to also pay them an annual incentive for continuing to participate. Moreover, they can reward customers for simply participating—or alternatively, they can reward based on the reduction in load they deliver. In our Rush Hour Rewards partnerships, we've observed three separate reward models:

PAY FIRST YEAR ONLY. The customer gets *only* an enrollment incentive.

PAY EVERY YEAR. Customers receive an enrollment incentive. They *also* receive subsequent annual payments. Those tend to be paid out at the end of the season, and are typically smaller than the initial offer.

PAY PER kWh. "Peak Time Rebate" models pay customers in proportion to the energy they reduce during rush hours.

As shown below in Figure 3, programs that pay a consistent amount to participants every year significantly outperform the other models. Why? For one, customers expect continuing rewards if they agree, time and again, to make a sacrifice, like enduring slightly warmer temperatures on a hot day. Second, initial rewards condition customers to expect future rewards. Enrollees tend to forget that they've agreed to reduce their air conditioning 2 or 3 years *after* receiving their enrollment incentive. Among those who were unsatisfied, the most frequent gripe was some variation on a single theme: "I am unhappy because I didn't receive my reward this year," even when they were in programs without recurring annual payments.

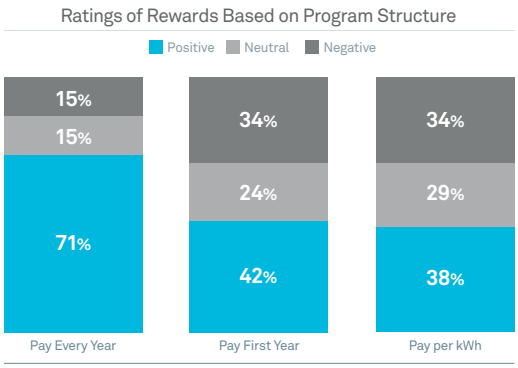

Figure 3.

Our most startling discovery? The *amount* that companies pay at the outset of the program has very little bearing on whether their customers are satisfied in the second year. Energy providers that pay heftier enrollment bonuses get no real bang for the buck when compared to those utilities that pay comparatively little. If anything, the bigger initial lumps spur customers to feel an even greater sense of loss when they fail to receive a reward in the second year. Of course, larger enrollment incentives can boost enrollment levels, encouraging *more* customers to sign up for the program—they just don't have much impact on overall satisfaction.

WHAT WE LEARNED #3:

With good program design, temperature adjustments are not as big of a problem as you think. But penalizing customers can be.

Rarely does a business do well by allowing free riders. As a result, we are not surprised to hear some argue that customers who make temperature adjustments during a demand response event should lose a portion of their reward. But our experience suggests that utilities derive very few benefits from penalizing their customers. Although some customers adjust the temperature on their thermostats during an event, in aggregate customers who begin an event still participate on average in 92% of the event.*

Our experience also suggests that penalizing customers is a strategic mistake. Here's why:

1. **CUSTOMER CONFUSION**. Complicated reward/penalty structures confuse your customers, discouraging enrollment.
2. **MULTI-PERSON HOUSEHOLDS**. In many cases, a diversity of people have access to a home's thermostat—not just the individual who pays the energy bill. No customer wants to be penalized because Grandma decided to adjust the temperature on a scorching hot day.
3. **HEADING FOR THE EXITS**. Homeowners who feel penalized for cooling a hot house are more likely to leave the program altogether.

So, what's a better way to do pay for performance? Rather than penalizing customers when they make adjustments, energy providers can pay DR vendors (like Nest) in proportion to the total load they provide. This type of compensation scheme provides the vendor with an incentive to deliver the greatest load at the lowest cost, while focusing on customer satisfaction and retention.

*From Nest's 2015 Rush Hour Rewards season. A customer is considered to be "participating" in an event to the extent they have not made adjustments that would increase their energy usage.

Which program is best suited for you?

Many energy providers have expressed interest in *Bring Your Own Thermostat (BYOT)* programs that require customers to buy their own thermostats, connect them, and then enroll in a DR program. Other programs take a different approach: In the *Utility Provided Device (UPD)* model, for example, the utility purchases and—historically—installs the device. Which model is best for your program needs? Let's take a closer look at the strengths and weaknesses of each model.

Bring Your Own Thermostat (BYOT)

BYOT programs have a lot going for them, and we've been proud to help market and grow quite a few. For one, utilities employing the BYOT model have to spend less up front to drive enrollment. Second, they don't need to subsidize professional installation. Finally, energy providers can reap the benefits of thermostat brand marketing done by device manufacturers, and take advantage of organic growth within the market for smart thermostats.

But there are drawbacks to BYOT as well. Organic growth does not happen speedily enough to enable programs to scale rapidly, particularly in areas where load control is needed most. Moreover, device-agnostic BYOT programs can exacerbate both complexity and cost. Utilities often find it challenging to manage a program's marketing, enrollment, dispatch and rewards when they're handling a range of different devices. They can ask a vendor to consolidate management onto a single platform—but that can be costly as well. In some cases, device agnosticism limits an energy provider's ability to take advantage of co-marketing efforts with the individual thermostat manufacturers.

Utility Provided Device (UPD)

Most utilities are broadly familiar with the UPD approach, having deployed millions of load control devices across hundreds of residential demand response programs. By recognizing the lifetime value these devices offer both the customer and the utility, energy providers have been able to capitalize these devices over their usable lives. And that provides a useful model for smart thermostats.

But thermostat-based DR programs can improve on the UPD model in at least one crucial respect. Whereas traditional UPD programs require the utility to both purchase and install the device, some connected thermostats like the Nest Learning Thermostat make it easy for customers to self-install. This gives customers more flexibility—not all customers want to have to schedule a professional installation—and helps energy providers lower their program costs. Manufacturers like Nest can also ship thermostats directly to customers who want to do the installation, further simplifying program logistics for the energy provider.

Why does the UPD model work? In most cases, these programs benefit from their relative simplicity: Customers enroll in a single program with a single product through a single message. The energy provider invests heavily up front—but then gets a bigger payoff down the line. And unlike a power plant, which requires several years of leading investment, DR benefits kick in from the program launch and scale with each thermostat. Recently, Nest announced that it has partnered with a midwest utility to replace and expand its existing DR program. By accounting for the long-term value of both DR and EE, the utility was able to give the Nest Learning Thermostats to its customers at no charge, while freeing up considerable funds for program marketing, professional installation, and even an incentive for those who choose to install the thermostat themselves.

> *"Utilities employing the BYOT model have to spend less up front to drive enrollment."*

Hybrid

And of course, thermostat-based DR programs can include a mix of delivery models. Energy providers can use this flexibility to reach a more diverse customer base, and fine-tune the program to both reach enrollment targets and stay under budget. A hybrid model merely combines any of the below approaches into a single program.

	Purchases Device	Installs Device
Bring Your Own Thermostat	Customer	Customer
Utility Provided Device	Energy Provider	Energy Provider (or Customer, for some thermostats)

Figure 4.

Choosing the Right Program Type

Four key considerations should factor into any energy provider's approach to designing a thermostat DR program.

SCALE. As discussed, BYOT programs are ideal when the goal is to grow smaller programs, but not when

you are trying to bring hundreds of MWs under management. In such circumstances, a UPD or a hybrid model may work better.

NEW OR REPLACEMENT. From recent US Energy Information Administration estimates, there are dozens of residential demand response programs with over 50,000 participants.* Many of these are older load control switch programs, often using outdated technology. If your goal is to replace thousands or tens of thousands of devices every year, a UPD program offers customers the opportunity to quickly receive a replacement thermostat at little or no cost. And unlike traditional UPD programs, you can choose to defray program costs by giving customers the option to install the thermostats themselves.

BUDGET & TIMEFRAME. BYOT is well-suited to budget-constrained programs and programs designed to last only a couple of years. UPD programs demand a longer time horizon and require the utility to tap additional resources for marketing, purchasing, and installing devices.

REGULATORY. UPD programs often require regulatory approval to capitalize the equipment costs and value the benefits of demand response (and at times energy efficiency) over a device's lifetime. This is not always possible given a regulator's accounting rules.

Conclusion

Over the last several years, smart thermostats have opened up new opportunities for residential DR programs, helping to achieve load management goals at reduced cost, while bringing additional benefits such as energy efficiency and improved customer satisfaction. Having worked with a diverse set of energy partners, Nest has been able to glean a much clearer picture of what induces customers to sign up for demand response programs, and what keeps them happy once they're enrolled.

Getting customers in the door.

- Make customers feel rewarded—up-front incentives paid directly to the customer pack the biggest punch.
- Although rewards are important, as many people are motivated to sign up for environmental reasons as for rewards. Different customers respond to different messages.
- And if you want a homeowner to participate in DR, help them understand what it is and why they should care.

Keeping customers satisfied.

- Rewards and comfort matter most, but you can't forget the impact of a customer's enrollment experience on overall satisfaction.
- Not all rewards are created equal—simple, annual reward structures outperform other models. And large one-time rewards can backfire when the customer expects the same reward again and discovers that it will not be forthcoming.
- Allowing customers to adjust the temperature when they are uncomfortable has a minimal impact on overall program performance. Moreover, there are real programmatic risks with moving to models that penalize customers for such actions.

Finally, much as we continue to be proponents of the BYOT model for demand response, other models offer a range of alternative benefits. UPD models work particularly well when an energy provider is keen to rapidly grow a new program or replace an existing one. And hybrids of these two approaches offer a range of possible solutions that are adaptable to a host of different programmatic goals.

Clear as the picture has become, there is more to learn. As residential DR continues to evolve, technology companies and energy providers will need to explore how best to take advantage of the unique characteristics of smart thermostats to make residential DR even more flexible and dependable. Beyond that, the energy sector as a whole needs to work collaboratively to leverage these products in the service of popular, cost-effective programs that deliver more than just peak load management. We at Nest look forward to those collaborations.

*U.S. Energy Information Administration, Electric power sales, revenue, and energy efficiency. Oct. 2016. https://www.eia.gov/electricity/data/eia861/