Navigating the Oncoming Storm: Opportunities and Challenges with Home Energy Management

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ABSTRACT

Home energy management (HEM) systems—comprising smart, networked devices that can provide information on, and dynamically adjust, energy use within a home—have been evolving for decades and finally appear poised to enter the mainstream. However, with hundreds of players getting into the home automation space, the increasing availability of myriad kinds of smart devices, an increased vendor focus on customer security and convenience over energy savings, and numerous other challenges, it can be daunting for even seasoned energy experts to try to figure out how best to approach this market, much less find ways to realize the many benefits HEM systems may be able to yield.

The good news is that most of the HEM devices currently available (across multiple manufacturers) tend to fall into several overarching product categories. Some of these are already beginning to see widespread market penetration, while others are still in the early stages of development and dissemination, and each offers unique opportunities for energy savings, demand reductions, and energy use information. With utility demand-side management pilots and programs around HEM devices just beginning to emerge and evolve, and given the rapid development of the underlying technology, HEM devices and systems appear likely to play an increasingly important role in the energy space going forward.

Introduction

Smart-home technology is quickly evolving, bringing with it unprecedented opportunities to collect data on—and control—myriad residential energy end uses. Far from being a passing fad that only wealthy millennial technophiles are likely to care about, recent market research suggests that the residential "Internet of Things" is starting to gain widespread traction in the market. For example:

- Data from the E Source Residential Customer Insights Center (drawn from the 2015 Energy Behavior Track survey conducted in partnership with The Nielsen Company) suggest that nearly half of all American consumers who are at least somewhat familiar with home energy management are interested in purchasing—or have already purchased—HEM devices.
- The Shelton Group's 2015 Energy Pulse study found that 35 percent of smartphone/tablet owners already manage some home function with a phone application (app), and 49 percent of the remaining owners plan to do so within the next year.
- Business Insider's 2015 Connected-Home Report found that shipments of connected-home devices (including smart appliances, safety and security systems, and HEM

devices) are likely to grow "faster than smartphone or tablet device growth," possibly reaching 1.8 billion units shipped in 2019.

For utilities and other players in the energy space, HEM devices can offer a broad range of benefits, including increased availability of detailed energy-use data; improved customer engagement; increased energy efficiency; and sophisticated new load-management and demand response (DR) functionalities. As disruptive developments like solar PV, battery storage systems, and electric vehicles become more prevalent in the market, and as utilities' goals for efficiency and carbon reduction become more stringent, the potential to control nearly all major energy end uses in the home may soon make HEM devices and systems an invaluable part of utilities' strategies for managing the grid.

An Overview of HEM Devices

The HEM market is evolving rapidly—existing devices continue to change and new wireless-enabled "smart" products keep emerging. Nonetheless, most currently available device offerings tend to fall into several general technological categories: smart thermostats, smart plugs, connected lightbulbs, smart appliances, and in-home energy-use displays (EUDs). Each of these devices has unique and distinct advantages and disadvantages, but effectively combined into an overarching HEM framework, they collectively have the potential to provide relevant, granular, and actionable energy-use information to prompt behavioral energy savings, directly reduce energy consumption through automated control algorithms, and provide sophisticated DR and load-shifting functionality.

Table 1 provides a high-level comparison of the costs and savings associated with these devices based on literature reviews of a range of independent research reports and utility program evaluations, along with discussions with manufacturers and other sources. Although the dynamic nature of the control algorithms used and the potential to prompt behavior change make it difficult to establish representative energy savings estimates for many HEM devices, the granular data they collect may offer new approaches to measurement and verification (M&V) going forward that will facilitate a better understanding of savings.

Table 1. Summary of common home energy management devices

Device	Typical retail cost	Energy-Saving Strategies*	Energy Savings Potential	Demand Reduction Potential
Smart Thermostat	\$100–\$300	Schedule setting, occupancy sensing, geofencing[1], maintenance notifications, HVAC	5–19% of HVAC energy consumption	0.7–1.6 kW

[1] In the context of HEM, geofencing refers to the ability of a device to track a user's location (e.g., using the GPS capabilities of a smart phone) in order to tell when he/she is home (or nearby) and adjust settings accordingly.

Device	Typical retail cost	Energy-Saving Strategies*	Energy Savings Potential	Demand Reduction Potential
		system adjustments, automation using weather data or input from home security components, education, behavioral prompts		
Smart Plug	\$20–\$60	Schedule setting, occupancy sensing, geofencing	8–21% of connected load	Varies; can achieve 0.4 kW with window air conditioners and 0.3 kW with dehumidifiers
Smart Appliance	Varies (generally comparable to high-end versions of each appliance)	Education around energy use	3–6% of appliance energy consumption	0.05–5.00 kW depending on appliance
Connected Lightbulb	\$15–\$100 (excluding a wireless hub or switch)	Schedule setting, geofencing	Unclear	Unclear
In-Home Display	\$100–\$450	Education and some behavioral prompts	4–15% of whole-home energy consumption	Unclear

*Note that not every product will offer all of these strategies; many just incorporate one or two. *Sources*: Buckley, Jacobson, and Snell 2015; Snell 2014

Smart Thermostats

Of all the HEM devices discussed in this paper, smart thermostats have been among the first to really flourish in the market, and customer awareness and adoption of these devices is continually increasing. In fact, 2015 data from the E Source Residential Customer Insights Center suggest that 5 percent of all residential customers have now installed smart thermostats in their homes. That growth is especially impressive in light of the fact that smart thermostats only really emerged onto the market in 2011 with the release of the Nest Learning Thermostat (Snell 2015). With straightforward programming, appealing online portals and mobile apps, attractive designs, and a better overall user experience than traditional programmable thermostats, it seems that smart thermostats are here to stay—in fact, their unique set of features may even help make them a central interface point for HEM systems going forward.

Although definitions vary, the term "smart thermostat" generally refers to a device that:

- Is able to run programs for each day of the week that use temperature setbacks during expected unoccupied periods.
- Features external communications that may include Internet connectivity, mobile app access, and data reporting.
- Can respond to inputs such as occupancy or customer preferences.

Many of the smart thermostats on the market offer a variety of energy-saving strategies, ranging from automatically trying to learn occupant preferences to behavioral prompts and tracking users' smartphones to turn down HVAC equipment when no one is home. Given the variety of energy-saving tactics involved and the technology's comparatively recent introduction into the market, research establishing average energy savings levels remains ongoing. However, utility program evaluations performed to date indicate that the level of HVAC energy savings realized has ranged from 5 to 19 percent (Buckley, Jacobson, and Snell 2015).

In addition to providing energy savings, virtually all of the smart thermostats on the market also offer sophisticated DR capabilities with two-way communication and comprehensive reporting functionalities that utilities can take advantage of. In many cases, smart thermostats are even able to combine multiple control strategies to maximize demand reductions while also maintaining occupant comfort—an improvement on previous generations of HVAC DR controls. Utility evaluations to date indicate that average per-home demand reductions have ranged from 0.70 to 1.60 kilowatts (kW) during utility DR events (Buckley, Jacobson, and Snell 2015). Those levels of demand reductions are generally similar to those achieved by traditional direct load control programs using switches, but the smart thermostats have been able to provide improved occupant comfort, longer potential event durations, and better data to support program managers.

Finally, in the context of HEM, smart thermostats offer another potentially enormous benefit. Because they're designed to know when users are home and can respond to DR signals—and users are likely to engage with the thermostat's screen (or mobile app) on an ongoing basis to adjust temperature settings—they may be great candidates to act as the central interface for HEM systems. Not only could they potentially replace EUDs as the source of information on a home's energy use, but they could also be well positioned to coordinate the way a home's HVAC, plug loads, lighting, and appliances respond to a DR event. Nest is a prime example of a company that is already moving in this direction—the thermostat's built-in ZigBee wireless compatibility allows it to talk to many smart meters, and its Nest Developer Program is fostering interconnectivity with a diverse array of smart products from other companies, ranging from connected cars to home appliances, security system components, and a broad range of consumer electronics.

Smart Plugs

Smart plugs—essentially a newer Internet-enabled version of smart power strips—are just starting to gain a foothold in the market. Whereas smart power strips generally provide 6 to 12 outlets and work by autonomously turning devices on or off based on the power draw of a single control device (like a TV), occupancy, or a preset schedule, smart plugs are Internet-enabled and typically offer one or two controllable outlets. Unlike smart power strips, smart plugs usually don't provide current- or occupancy-based control strategies; instead, they allow users to set schedules for their plug loads, turn them on or off remotely via an online portal or mobile app, and even monitor each plug load's power draw (the kind of granular data that studies show is most effective in getting users to change behavior). Given this functionality, a number of smart plugs are currently being marketed as residential lighting controls (for plugged-in lamps) that can not only save energy but also provide security benefits by allowing users to program lights to turn on and off when they're away from home—an electronic version of the old mechanical timers. Current estimates of potential energy savings from smart plugs range from just a few percent to over 20 percent of the connected load.

Many smart plugs also provide DR functionality, potentially giving utilities even more options to consider for their load management programs. One notable example of such an effort is Consolidated Edison's (Con Edison's) CoolNYC program, initially launched in 2011, which was one of the first programs in the US to target window air-conditioning units for DR purposes using a smart plug called the ThinkEco Modlet. The program has been very successful to date: Con Edison now has tens of thousands of participating customers, with each smart plug providing an average load drop of around 0.4 kW. Unsurprisingly given Con Edison's positive results, utilities like Baltimore Gas and Electric, Commonwealth Edison, Consumers Energy, and CPS Energy have all recently started to offer their own window air-conditioner DR programs as well.

Another intriguing example (also using the Modlet) was a pilot by Wright-Hennepin Electric Cooperative using smart plugs to control residential dehumidifiers in Minnesota for DR purposes. Results for this program were impressive, with average demand savings of around 0.3 kW per home and opt-out rates close to zero.

Despite the inherent flexibility of smart plug devices, the main barriers to further market penetration appear to be their high up-front costs, a lack of awareness about these products on the part of customers and utilities, and (with the possible exception of the smart products focused on lighting) a somewhat vague value proposition to end users who may not know how best to implement them. However, these products are still relatively new and it seems likely that the market will continue to evolve, removing many of these barriers as time goes on.

Smart Appliances

In broad terms, smart appliances are designed to automatically adjust power draw based on control signals from a utility, with some also providing granular energy-use data or offering users the ability to control them via a mobile app. The utility signals could be related to changing electricity prices, a DR event, or even the real-time availability of renewable energy on the grid. The exact control strategies employed tend to vary depending on the type of device and the manufacturer (M. Valmiki et al. 2013)—and users can override all of these features if desired—but some examples of smart appliances and their capabilities include:

- Clothes washers that can delay the start of the wash cycle, recommend using cold water instead of warm or hot water, or reduce power to the motor and/or heater

- Clothes dryers that can postpone the beginning of the dry cycle, automatically enter an energy-saving mode, or reduce heater power draw for a set period of time
- Refrigerators that can delay the time of their next defrost, raise the freezer temperature setpoint by a few degrees, or disable anti-sweat heaters (if applicable)
- Dishwashers that can delay the wash cycle or turn off their heaters during the drying stage to reduce power
- Electric ranges with multiple ovens that can prevent the larger oven from heating up, prevent self-clean, reduce burner heat output, or even disable burners entirely
- Microwaves that can reduce power output (leading to slightly longer cook times), reduce lamp light levels, or reduce fan speed
- Electric storage water heaters that can adjust temperature setpoints, turn off the heating elements entirely, or ramp heating elements up and down dynamically (even on a second-by-second basis) to provide energy storage and frequency regulation

Smart appliances aren't necessarily inherently more energy efficient than "dumb" appliances (though they are often ENERGY STAR–qualified), but some energy savings may be realized during DR events or critical peak pricing periods as a result of prolonged power reductions. In addition, for appliances that share their energy-usage data, some savings may be associated with the "feedback effect" (in which the availability of detailed, device-specific energy consumption data helps end users improve efficiency). Although little research currently exists to quantify the magnitude of the efficiency benefits from the feedback effect, researchers from the Pacific Northwest National Laboratory have estimated an average per-appliance reduction in energy consumption of between 3 and 6 percent as a result of this energy-use feedback (Sastry et al. 2010). Similarly, researchers from the Northeast Energy Efficiency Partnerships (NEEP) estimate that potential whole-house energy savings from smart appliances is less than 1 percent of a home's total consumption (NEEP, 2015).

Despite the fact that smart appliances may offer a number of potential benefits to utilities that are interested in load management, a number of challenges are still to be resolved. Not only are these features typically available solely for appliances in premium price tiers, but the load-shaping and DR capabilities can be difficult to explain to end users, and many of the power-reducing features have the potential to directly impact users in a negative way. For example, in a worst-case scenario, a customer may pay a lot for an appliance that doesn't always do what he wants in order to get benefits he doesn't fully understand. Likely as a result of these kinds of problems, smart appliances have remained fairly niche products over the years, and it's unclear how successful they may be in the future. A notable exception is grid-interactive electric water heaters that seem to be able to provide substantial demand-management benefits without leaving users in cold water. This technology may offer multiple benefits in regions where electric water heaters are prolific, and recent research suggests that it's one of the most cost-effective forms of energy storage currently available (Podorson 2014). As a result, a number of utilities—including Great River Energy, HECO, Sacramento Municipal Utility District, PowerShift Atlantic, CenterPoint Energy, Xcel Energy, Connexus, East River Energy, and National Grid Rhode Island—now have in place (or are exploring) pilots and programs using grid-interactive water heaters to manage load.

Connected Lightbulbs

LEDs aren't just more energy-efficient than other lighting technologies; they're also more controllable. On top of that, they also last much longer than other lighting technologies, leading manufacturers to look at new ways of encouraging end users to replace lamps before their expected end of life. To take advantage of the unique features that LEDs offer while also beginning to treat these products as consumer electronic devices that users will want to upgrade on a recurring basis (Krepchin, 2014), a variety of manufacturers are now selling Internet-enabled LED products that can be controlled remotely and, in some cases, offer additional functionality like the ability to change color.

Especially considering the substantial costs of these connected bulbs, their main selling points thus far have been convenience, security, fun, and even health benefits (Walerczyk, 2015). The focus has generally not been on energy savings yet, but some products do offer features like dimming based on ambient light levels or geofencing that can turn the lights off when a user leaves his house (as determined by the location of the user's smartphone). Similarly, although there's no inherent reason that these bulbs can't be used for DR purposes, there does not yet seem to be a concerted effort to actually make this a reality. However, smart bulbs represent another nascent "smart" market that bears continued observation, and it's certainly possible that connected bulbs may begin to offer a more robust set of energy and demand benefits going forward in addition to the many non-energy features they already provide.

In-Home Energy-Use Displays

EUDs were once considered an essential HEM technology, but utility interest in—and activity around—them has been waning in recent years, and the devices may soon be made obsolete as the valuable information they provide becomes available through a variety of other channels instead (including mobile apps, web portals, and possibly smart thermostats). At their most basic, EUDs are physical displays that show users how they're consuming energy (often using data from a smart meter). Depending on the level of sophistication involved, an EUD may also provide historical data for comparison, show current electricity prices, and provide communication from the utility. The main purposes of all this information are generally to:

- Educate customers about how they use energy, with the goal of promoting energy-efficiency behavior change
- Provide time-of-use (TOU) customers with the information they need to minimize their utility bills by shifting their power draw away from peak periods.

A variety of studies have shown that intermittent whole-home energy consumption data is less effective at promoting behavior change than up-to-date, granular, device-specific data, which can prompt savings of 15 percent or more (Snell, 2014).

Despite the benefits offered by the data EUDs provide, several problems make their future prospects dubious. A variety of utility representatives have indicated that the devices can potentially require technically complicated installations and are generally difficult to find through retail channels. Additionally, the persistence of user engagement—much less the energy-efficiency benefits—remains unclear. However, the biggest problem is simply that, as customers increasingly adopt mobile devices like smart phones and tablet computers, it's logical for them to choose an energy-use app that works with their existing device rather than purchase and install a stand-alone EUD. For example, weather company WeatherBug now allows customers to add utility smart meter data directly into its free app to help them better understand and even predict their energy bills. Additionally, as smart thermostats gain traction in the market, they may provide an ideal platform to engage customers around such topics as energy consumption, TOU pricing, and DR events, making EUDs redundant. Time will tell, but it seems possible that the era of stand-alone EUDs has come and gone.

The Potential for Interactive Benefits

Although it remains to be seen how interconnected HEM devices will ultimately become, there are a variety of potential energy-efficiency benefits offered by more comprehensive systems that may not be available at the individual device level. For example, the Alarm.com Smart Thermostat is able to monitor contact sensors throughout a house that were installed as part of the home's security system and automatically pause or setback the HVAC system if a window or door is open while sending an (optional) alert to users to let them know what it's doing. Similarly, ceiling fan company Big Ass Fans partnered with Nest in 2014, enabling Nest's thermostats to control Big Ass Fans' residential Haiku product (for example, turning the fan off when no one is home) in addition to the HVAC systems the thermostat is already able to control. Such examples highlight a few of the ways that interconnection may open up new opportunities for energy efficiency.

Another opportunity presented by interconnection is increased availability of energy usage data for the end user. Irrespective of the individual HEM devices themselves, research has consistently shown that customers value energy-use feedback and will often act on it to realize additional energy savings—at least in the short term (Sastry 2010). In the case of HEM systems, however, it's unclear where this data will come from (for example, appliance-level energy-consumption data could come directly from devices within the home, or it might be disaggregated out of a single stream of smart meter data) or how customers may access it. Some potential options may include:

- A networked EUD that can talk to smart devices in the home (though this may not necessarily be the best long-term option, as outlined in the EUD section above)
- An all-in-one HEM web portal that shows data and allows customers to adjust their devices from a single place
- A utility-provided mobile app that just provides the energy-use data (and maybe offers suggestions on how to reduce consumption)
- Customers' smart thermostat displays and apps

All of these approaches are viable with current technologies, but figuring out which specific strategies will work best in the long run will likely require utilities and HEM manufacturers and vendors to work together. Particularly given that many HEM devices currently offer standalone apps and may not share data effectively with other devices unless connected to a central hub, it seems that partnerships will be vital in realizing the benefits that interconnectivity may eventually provide.

Finally, for utility load management programs, HEM device interconnection may facilitate more robust DR and load-shifting functionality. For example, having a house full of devices that coordinate their duty cycles and intelligently respond to DR events could potentially help to drive significant demand reductions without negatively impacting customers. Such capabilities are still largely in development, but may warrant continual observation from utilities and other major players in the energy industry given the potential benefits they may offer.

Emerging Utility HEM Initiatives

Utility smart home initiatives are still in the early stages, and many of them are primarily focused on load shifting and user engagement rather than on energy efficiency—something that's not particularly surprising given the lack of robust established energy savings data and the ongoing challenges around M&V that these devices currently present. In general, the utility pilots and programs involving multifaceted home energy management systems (comprising multiple devices, as opposed to those focused on a single HEM device like a smart thermostat) that have been run to date highlight three fundamental approaches utilities have taken with respect to HEM offerings:

- Take ownership of developing an HEM offering, working to develop a custom system from the ground up in order to maintain the utility brand and reduce uncertainty about issues such as who owns HEM device data and the overall customer relationship.
- Partner with third-party vendors to streamline the utility program, give participants more choice about which devices they install, and reduce program costs (thereby improving overall program cost-effectiveness).
- Install and study HEM technologies in new-construction projects to better understand the potential benefits and to learn more about the underlying ecosystems involved.

Each of these approaches offers unique challenges and benefits, but all of them are helping to establish the role of HEM in utilities' program portfolios. The four case studies below provide additional insight into why different utilities have taken the approaches they have and how their offerings are evolving over time.

Reliant Energy

Reliant Energy is among the most prominent examples of utilities that have worked to create their own custom HEM system from the ground up. As the retail electric provider branch of NRG Energy serving the deregulated Texas market, Reliant has built up a substantial portfolio of rate structures for its customers. It was among the first to partner with smart thermostat manufacturer Nest, using the product as a perk for customers that signed up for a particular rate structure. The thermostat offering was very successful, but over time Reliant began to become concerned that they were giving up ownership of the customer relationship by relying so strongly on a third party and started looking at other options. Late in 2014, Reliant launched its own custom-built home security and automation service that highlighted the Reliant brand prominently in both the mobile app and the system as a whole. The overall intent of its offering was to start with home security and have one offering lead to the next, deeper and deeper into the home, creating strong customer relationships in the process.

Largely eschewing vendor partnerships, Reliant created its own comprehensive smart home package from scratch, going beyond a focus on energy to also include home security and monitoring services. Customers can use Reliant's app to arm and disarm their security system, open and close their garage door, and turn their lights on and off even when they're away from home. They can also lock or unlock their doors remotely to let family, friends, contractors, or others into their house, and keep an eye on their home with video cameras that record based on specific actions, such as when the alarm is triggered. Customers can then use the mobile app to connect to devices via the gateway, set schedules for appliances and lights using their smartphone, and lower cooling and heating bills by setting a smart schedule for their thermostat.

Southern California Edison (SCE)

California investor-owned utility (IOU) SCE is positioning itself to take advantage of the ever-evolving load-shifting capabilities offered by different HEM devices by building off of its successful smart thermostat DR offering that leverages a variety of vendor partnerships. In its current bring-your-own-thermostat (BYOT) program, it provides a set fee per enrolled customer to different thermostat vendors, along with a rebate of $1.25 per kWh reduced to customers that participate in DR events. By putting the responsibility for marketing the program onto third-party vendors, SCE has seen a substantial increase in cost-effectiveness per kW reduced during DR events, and customers have indicated they appreciate the choice offered by the program.

To take the program to the next level, SCE created a universal contract designed to be applicable to any vendors that may want to participate in its DR offerings with the eventual goal of turning its existing BYOT program into a "bring-your-own-device" program that could encompass any smart device capable of reducing load during DR events. At present, the contract requires participating devices to work with the OpenADR communication framework, and SCE is actively looking to expand the list of HEM vendors it partners with going forward.

Commonwealth Edison (ComEd)

Much like SCE, Illinois utility ComEd hopes to transition its smart thermostat DR program into a more expansive "bring-your-own-device" program going forward. It currently works in partnership with Comcast Xfinity and Nest Labs to offer substantial incentives for customers that agree to participate in DR events. Residential customers who have a Nest Learning Thermostat and enroll in Nest's Rush Hour Rewards (Nest's residential DR offering), or who have an Xfinity Home Thermostat and enroll in the Xfinity Home Summer Energy Management program, receive $40 in incentives from ComEd for allowing the utility to adjust temperature setpoints during DR events. Xfinity customers who enroll can also receive a free smart thermostat, making it a particularly attractive offer.

Sacramento Municipal Utility District (SMUD)

In contrast with the utility offerings discussed above, California municipal utility SMUD offers an ongoing Smart Homes new construction program that encourages builders to construct energy-efficient homes that are equipped with enabling technology for future demand-response and energy-efficiency opportunities. By incentivizing energy-efficient construction, LEDs, Wi-Fi and/or ZigBee-enabled thermostats, ENERGY STAR-qualified appliances, good building orientation for PV panels, and plug-in capabilities for electric vehicles, SMUD's program helps it maintain strong customer relationships while also enabling it to learn more about the pros and cons of different connected systems. Perhaps most importantly, the program is helping position SMUD to create new DR and energy-efficiency programs that will help it better integrate load impacts from solar PV systems and electric vehicles going forward.

SMUD also has a Home of the Future Demonstration Program in partnership with local builders that is intended to result in new homes that consume at least 80 percent less energy than comparable homes and have zero peak demand. The program tests out a wide range of innovative new-construction techniques and efficient technologies that, if successful, can then be shared with the local builder community and incorporated into SMUD's other programs (including their Smart Homes offering). As part of the program, HEM systems are installed in each home that can control HVAC, lighting, office, irrigation, and home entertainment loads in order to maximize energy savings. Ultimately, SMUD hopes that the Home of the Future program will facilitate the construction of true net-zero-energy homes in their service territory that are able to produce as much electricity as they consume.

Conclusions and Recommendations

The HEM market offers a range of potential benefits for utilities and other players in the energy space, from sophisticated energy efficiency and DR capabilities to granular energy-use data and the potential for improved customer engagement. On top of that, expected market developments such as growing penetration of solar photovoltaic and energy storage systems, and ongoing developments around electric vehicle charging, appear likely to make HEM systems increasingly relevant to end users, utilities, and other players in the energy space by amplifying the need for dynamic residential load management to help balance the grid. However, given the many potential selling points of smart home devices, HEM vendors and manufacturers may not always understand—much less prioritize—the types of energy management capabilities that utilities and others might prefer that they focus on. For these reasons, HEM systems may represent a major opportunity for energy industry partnerships. Utilities and other interested parties would be well advised to closely follow developments in this area and to develop a strategy for interacting with this fast-changing market.

For demand-side management programs focused on energy efficiency, the kinds of HEM ecosystems being promoted by third-party companies—particularly those offering home security services—may pose potential threats to utilities given the free-ridership issues that may arise if utilities choose not to form partnerships or create their own system from the ground up (since customers may have energy-saving HEM devices installed by a third party without a utility incentive, making it impossible for the utility to claim savings). With that in mind, utilities will likely be able to go one of two ways: develop their own smart home offering (as Reliant Energy is doing), or work with major HEM players to offer mutually beneficial joint offerings (as ComEd and SCE are doing).

Where DR and load management are a priority, it may be worthwhile for utilities to forge relationships with prominent third parties and manufacturers that seem likely to have influence in this area, along with other companies that may ultimately help shape the demand-management functionality of HEM devices going forward. As evidenced by the experiences of utilities like SCE and ComEd, allowing third parties to get DR-ready devices into homes that utilities can then control to manage demand on the grid can be a successful and cost-effective approach to load management, with a dynamic and customer-friendly DR resource that's likely to continue to grow in the future. Furthermore, partnerships established soon may enable utilities to have more influence in the development of residential load-shifting technologies going forward.

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