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Breaking Down Barriers to Residential Demand Response

The Federal Energy Regulatory Commission has identified demand response as a "killer application" for the smart grid.

With residential and small commercial customers' consuming 80 percent of the electricity used in buildings (excluding industrial facilities), significant potential exists for reducing peak demand. Yet despite the upside benefit, residential demand response programs remain stuck in the pilot stage at nearly all utilities.

Most utilities are progressing slowly on residential demand response because the barriers seem too great. But every one of the perceived barriers to residential demand response—whether technical, regulatory or involving consumer adoption or utility integration—can be overcome with manageable risk.

THE BIGGEST BARRIERS—PERCEIVED AND REAL

Consumer acceptance of dynamic pricing and other changes associated with demand response could be a barrier to widespread adoption and, therefore, a barrier to reducing peak demand. But several studies show the issue is consumer education—and simple education through effective messaging to provide meaningful insights into why demand response and dynamic pricing are related and beneficial. The more consumers understand the problem, the more willing they become to participate in the solution. IBM's 2011 Global Utility Consumer Survey, for example, found that respondents who were most knowledgeable about energy issues were 64 percent more likely to change their usage patterns.

Similar results were revealed in the 2011 Consumer Pulse Survey conducted for the Smart Grid Consumer Collaborative. A full 80 percent of respondents strongly or somewhat agreed the smart grid would help them save money, avoid wasting energy and make the grid more reliable.

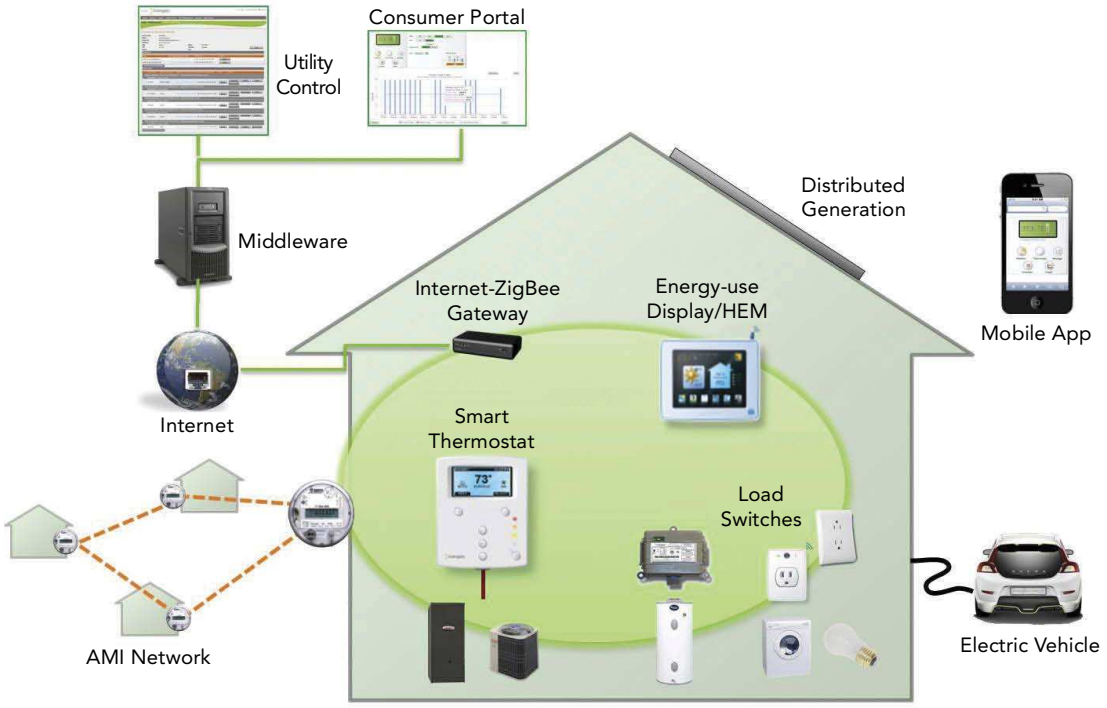
Political correctness also ranked favorably, with 78 percent strongly or somewhat agreeing the smart grid would protect the environment better and make the U.S. more energy independent. Seventy-five percent also want more control over home energy use and rate and billing choices. And with the constant barrage of consumer advocate pressure to make demand response programs voluntary, there is nothing more voluntary than letting consumers choose how much they are willing to buy at a certain price.

Because consumers are more accepting of change, utilities no longer have any excuse for postponing the inevitable migration to dynamic or time-based pricing. That is not to say this migration will be painless. Because static residential rate structures have long been the norm, the industry has little experience with time-of-use (TOU), critical-peak and real-time pricing rate structures. The bad news: Because these dynamic rate structures are new, the industry will not get them perfect at first. The good news: Once implemented, changes to dynamic rate structures are easy to make (albeit with some regulators' and utility executives' potentially experiencing a few battle scars). Early experience shows that fear of making this "major," inevitable change is exaggerated.

A wireless ZigBee home-area network is served by a broadband Internet gateway and an AMI network. Note the ability to control other loads, including the charging of electric vehicles, which will be supported in future versions of SEP.

If consumer acceptance is not a

UTILITIES NEED DEDICATED GATEWAY



barrier, perhaps it's the perceived maturity of standards needed for home energy management and home-area networking. But the requisite standards on the consumer side of the meter are proven in numerous pilots and some production rollouts.

The critical standard is the Smart Energy Profile (SEP). SEP 1.x was created by the ZigBee Alliance as the application-specific upper layers of the ZigBee wireless networking protocol and is available. SEP 2.0 is network-agnostic, which has earned it additional support from other organizations, including the HomePlug Powerline Alliance, HomeGrid Forum, SunSpec Alliance, Wi-Fi Alliance, IPSO Alliance and International Society of Automotive Engineers. Based on its robustness, maturity and widespread support, SEP 2.0 was selected by the National Institute of Standards and Technology for residential demand response in the Smart Grid Interoperability Standards Framework. Although SEP 2.0 might be years away, some vendors will be able to upgrade their SEP 1.x devices over-the-air to support SEP 2.0.

Another barrier to residential demand response presents a problem: the lack of robust, inexpensive, two-way communications between some utilities and their residential customers. The smart grid's advanced metering infrastructure (AMI) should be able to provide sufficiently robust communications to support dynamic pricing, but that is not always the case depending on other applications' using the AMI communications path, such as distribution automation. What can utilities without an AMI—or a sufficiently robust one—do to implement a comprehensive residential demand response program? Use an existing network that already reaches nearly every home: the Internet.

AN AMI ALTERNATIVE

According to Parks Associates, some 45 percent of all U.S. households will be served by smart meters by the end of 2015, but as few as 10 percent of those will be enabled for two-way communications between a home-area network (HAN) and their utility's back-end systems. Other analysts predict more or less smart meter or HAN penetration, yet the result is the same: The end-to-end, two-way, near-real-time communications needed for system operators to send pricing signals and monitor demand response actions might be a missing link.

Enter the Internet. It provides reliable, secure broadband communications in every utility's service area and

is installed in 63 percent of U.S. homes. The penetration in larger residences with the highest potential return on the demand response investment is even greater. And broadband penetration will continue to increase as digital subscriber line (DSL), cable modem, third- or fourth-generation (3G or 4G) cellular communications and satellite services are expanded, and competition among these alternatives lowers subscription rates.

All that is needed for utilities to take advantage of the Internet's ubiquity is a dedicated gateway (see figure on Page 29). The gateway provides continuous, two-way communication between the utility and the consumer's home energy management system devices, such as programmable communicating thermostats (PCTs) or in-home displays. The gateway establishes a secure service entrance into the home by connecting both to the broadband modem via Ethernet and to the ZigBee, Wi-Fi or other HAN. The gateway is configured for secure, encrypted communications between the utility's demand response application and the in-premises system, and if the utility chooses, voluntary direct load control.

What happens when a home has a utility-provided smart meter and a consumer- or utility-provided Internet gateway? SEP 1.1.1 includes a provision for more than one energy services interface (ESI), which is the gateway into the HAN. In addition to this gateway function, each network also must have trust center and network coordinator functions; the smart meter, the point of demarcation between the utility and the premises, normally provides all three functions. Support for multiple ESIs enables the trust center function to have different gateways into the same HAN in a secure fashion, changing the HAN from a utility's AMI-limited interface into a robust consumer platform that preserves the integrity of the utility's program while enabling shared control with the consumer. Another advantage of having an Internet gateway for the utility is the ability to implement more voluntary applications, particularly those requiring higher bandwidth than the AMI supports.

MAXIMIZING CONSUMER ACCEPTANCE

Even with consumers ready for residential demand response, standards sufficiently robust and mature, and the Internet's ability to serve as a separate or companion network to AMI, another potential barrier exists: the home energy management system. Most consumers still have difficulty programming microwaves and digital video recorders; how can they be expected to make the optimal trade-offs necessary to balance energy consumption with personal comfort? The best home energy management systems make these trade-offs automatically and prudently based on an individual customer's general preference while providing a mechanism to help the consumer tweak that preference.

The ideal home energy management system should operate like the dial on an old-fashioned thermostat, enabling users to crank down the cost or crank up the comfort—or chose something in between favoring one or the other. For consumers who are enthusiastic about home energy management, more in-depth optional capabilities also should be available. These include: switches and outlets for controlling other loads; sophisticated energy management displays, potentially as dockable stations; Web portals showing detailed usage information; and mobile device apps that enable users to check and change settings while not home, perhaps from a second or vacation home that also has its own remotely controllable home energy management system.

Operational simplicity combined with good customer communications works—and not just in pilots. Oklahoma Gas & Electric (OG&E) had such tremendous success with its pilot that the utility is embarking on a large-scale roll-out to nearly 40,000 customers by the end of 2012, with more to follow. Pike Research calls OG&E's demand response program "one of the most advanced initiatives in the industry to date," and the firm's forecast of a 38 percent annual growth in residential demand response services during the next five years reveals an expectation that other utilities will be following OG&E's lead shortly.

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