From direct load control to flexible grid management: The evolution of demand response

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Key takeaways

- Some administrators are pairing smart technologies with rates and pricing programs; others are developing offerings that address demand and supply issues.
- New technologies are enabling demand response (DR) in multiunit dwellings.
- Legislation and efficiency standards are encouraging manufacturers to build DR capabilities into their products.
- Several new residential battery storage pilot programs highlight these systems' potential to shed load without adversely affecting customers.

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Utility DR programs are undergoing a major change. They're moving from traditional one-way direct load control to flexible, dynamic approaches that use behind-the-meter devices to meet grid needs, maintain high

customer satisfaction, and support increased adoption of renewables. And some utilities are pairing these strategies with special rates. We've identified five trends that are leading this transition.

What is DR?

According to the US Department of Energy, DR "provides an opportunity for consumers to play a significant role in the operation of the electric grid by reducing or shifting their electricity usage during peak periods in response to … financial incentives." DR helps utilities balance supply and demand. Check out our Fundamentals of demand response for a thorough discussion of DR and its value to utilities and their customers.

Bundling time-based pricing with smart devices for DR

Though time-based pricing strategies like time-of-use (TOU) rates and critical peak pricing have been around for years, utilities are only beginning to realize their potential. Research has shown that combining rates with an enabling technology significantly increases the effectiveness of those rates. The 2017 ACEEE report Rate Design Matters: The Intersection of Residential Rate Design and Energy Efficiency demonstrated that even noncommunicating devices, such as in-home displays or programmable thermostats, enhance the effectiveness of rates. Since then, utilities across the US and Canada have increasingly started to use connected devices to automate responses to time-based rates. Here are a few notable examples.

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Ontario. In its May 2019 Peak Load Management Alliance (PLMA) presentation The You in Time of Use (PDF), smart thermostat manufacturer Ecobee claimed that its Peak Relief pilot in Ontario achieved peak period TOU savings of 20%. The province's previous TOU rollout, which didn't include a thermostat, achieved peak reductions of 0.7% to 2.1%.

ComEd. ComEd offers an IFTTT (If This Then That) web service to help customers participating in the utility's Peak Time Savings and Hourly Pricing programs create applets. These applets work with a variety of energy-related smart home products and can automatically adjust device settings based on pricing signals or alert customers to high energy prices.

DTE Energy. The utility's SmartCurrents program offers a no-cost smart thermostat to residential customers who enroll in a TOU rate with critical peak pricing. And the DTE Insight app, available to all customers, can help TOU subscribers understand their home energy use and manage it from their smartphones.

PG&E. The utility launched a smart thermostat TOU pilot in late 2018. According to the 2020 evaluation, Eco+ Thermostat Optimization Pilot (PDF), participating PG&E customers reduced demand by 20% to 28% during peak hours.

Using connected devices to facilitate DR in the multifamily sector

Historically, utilities have struggled to administer DR programs for residents of multiunit dwellings because of unreliable Wi-Fi and frequently changing tenants. But Austin Energy and Portland General Electric (PGE) have cracked the code.

> **Austin Energy launched a DR program for small businesses and residents of multiunit dwellings that doesn't rely on a Wi-Fi signal.**

For income-qualified customers in apartments and condos, Austin Energy pairs its Power Partner Thermostats program with a comprehensive package of energy-efficiency measures such as duct sealing, an air-conditioning tune-up, LED lighting, insulation, and solar screens. The utility also launched a DR program for small businesses and residents of multiunit dwellings that doesn't rely on a Wi-Fi signal. It uses Resideo's distributed energy resource management system and mesh network to send DR signals to Pelican Wireless thermostats. Tenants enroll individually, and landlords retain access so they can troubleshoot individual units during unoccupied periods.

Taking a different but no less successful approach, PGE offers a Connected Water Heaters program for the multifamily sector. Property owners with at least 50 eligible units can receive an incentive of $20 per water heater per year for five years. PGE installs an Aquanta or Apricity load control device on tenants' water heaters and handles device maintenance.

Developing guidance for responsive appliance design

We're starting to see the market change for DR-enabling devices through the implementation of communication standards and specifications like CTA-2045, an open standard. In 2019, Washington passed House Bill 1444, which mandates that electric storage water heaters installed or sold in the state must be compatible with CTA-2045 beginning in 2021. And manufacturers are starting to develop products that are CTA-2045 compliant. For example:

- A. O. Smith offers electric resistance and heat-pump water heater models with CTA-2045 ports
- Emerson offers a CTA-2045-compatible retrofit controller for existing water heaters
- Vaughn includes CTA-2045 ports in its electric water heaters

This support from policymakers and manufacturers will create more grid-enabled appliances and increase the cost-effectiveness of residential DR programs. And customers will start buying these technologies regardless

of whether their utility offers rebates for them.

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California is also advancing legislation around DR-enabled devices. Approved in October 2019, Senate Bill 49 requires the California Energy Commission to adopt appliance standards for Flexible Demand Appliances, though it's unclear what the standards will look like.

At the national level, ENERGY STAR is adding DR and TOU components to its new specifications for connected devices, from its Smart Home Energy Management Systems specification to the new Pool Pumps specification expected to launch July 2021.

Getting demand savings from battery owners

Another exciting trend for both resiliency and load management is residential battery storage. Utilities are just starting to launch or pilot residential battery DR programs, but the early results are promising.

Green Mountain Power's (GMP's) Bring Your Own Device program, offered in conjunction with Renewable Energy Vermont, helps residential and small business customers save money, cut carbon emissions, and reduce peak loads. Eligible devices include vehicle chargers, water heaters, and batteries from SolarEdge, Sonnen, Sunverge, Tesla, and Generac.

> **GMP's battery DR program helps residential and small business customers save money, cut carbon emissions, and reduce peak loads.**

Customers can enroll a battery for 10 years and receive either an up-front payment of $850 to $950 per kilowatt (kW) of storage, depending in the length of the discharge, or an equal amount in ongoing bill credits. Customers in certain areas with high storage needs are eligible for an additional $100 per kW. Enrolled customers agree to pay a $2.50 integration and communication fee per month on their bill and to allow GMP to use their batteries to offset power demand during peak events. According to the utility, peak events happen five to eight times per month and last an average of three to six hours. GMP alerts customers via smartphone app at least four hours before a peak event. During weather-caused outages, the utility ensures that customers' batteries have stored energy.

National Grid ran a similar DR program in 2019. According to the 2019 Residential Energy Storage Demand Response Demonstration Evaluation, the program achieved average load savings of 5.5 kW per battery during

each two-hour event. And because the utility was controlling the battery rather than the end-use devices, most customers weren't even aware the events were happening. The program earned a 97% satisfaction rating from participants, likely due to its nonintrusive nature.

Designing programs that manage demand and excess supply

California utilities struggle to manage not only peak demand but also excess renewable generation, especially in the middle of the day. In 2015, PG&E launched its Excess Supply DR Pilot (XSP) "to address intermittency due to oversupply of renewables generation as distributed generation accelerates." Participants offer a minimum load increase of 30 kW across a two-hour event, and the utility pays incentives of $5 to $10 per kW per month, depending on the level of participant availability and the expected number of events per month.

> **PG&E launched XSP "to address intermittency due to oversupply of renewables generation as distributed generation accelerates."**

The utility's March 2020 Excess Supply DR Pilot 2019: Summary and Findings (PDF) demonstrated PG&E's ability to use customers to mitigate excess supply. And some customers were able to respond to an excess-supply event and shed load on the same day. XSP has been more appealing to larger commercial customers than residential or small commercial customers, and some customers have avoided incremental demand charges through savvy bidding.

PLMA recognized the pilot as a Program Pacesetter during its 16th PLMA Award Winners in April 2019. According to PLMA, "The XSP is the first step of what is to come with regards to developing participation models that can fully utilize resources with these flexible characteristics as a service to the grid."

Need more DR advice?

Members of the E Source Demand-Side Management Service or Technology Assessment Service can check out Smart home pilots and programs: A 2020 snapshot of utility initiatives. It includes information on programs that use connected devices to facilitate DR.

Demand-Side Management Service subscribers can read our answer to the member question Which method is more effective for demand response: Time-variant pricing or direct load control?

Gas demand response: Pilot and program design and results, for members of the Demand-Side Management Service, highlights progress in several utility pilots and programs.

Mopping up the solar spill: Using optimized managed charging to absorb excess solar generation explains how managed electric vehicle (EV) charging programs at workplaces can help utilities balance excess

renewable energy with increased demand from EVs on the grid.

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