What are the fundamentals of demand response?

An Ask E Source answer
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Q:What is demand response (DR)? How do we explain its value, and how can we determine whether we should be doing DR at our utility?

A: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. It typically takes the form of time-based pricing, such as time-of-use rates and critical peak pricing, or direct load control (DLC) programs. When residential customers participate in a DLC program, they give the utility control over their air conditioner or water heater during periods of peak demand in exchange for a bill credit or other financial perk. When commercial and industrial (C&I) customers participate in DLC, they shed load for a specific number of hours per year at the request of the utility and get reduced rates or bill credits in return. Utilities get most of their DR savings from the C&I sector.

The value of DR

Conventionally, the value of DR could be quantified in terms of the value of peak kilowatts (kW) reduced ($ per kW saved), but DR offers additional value because of its flexibility as a resource. When deciding whether to build a DR strategy, you should also consider its ability to allow you to:

- Defer or avoid infrastructure upgrades
- Balance the grid
- Diversify your resources

To provide a broad view of the value of DR, we interviewed Ken Black, chairman of the E Source board of directors and former E Source president. Ken has more than 30 years of utility experience.

Investing in DR is more than a financial decision; it's a matter of developing resource flexibility and planning for the utility of the future.

He explained that in some regions, especially those with significant hydroelectric resources, it may be difficult to justify DR on economics alone. However, we recommend moving beyond conventional thinking when considering a DR strategy. Investing in DR is more than a financial decision; it's a matter of developing resource flexibility and planning for the utility of the future.

In the near term, the unique value of demand response is in its flexibility as a resource. DR allows utilities to shift their loads in new ways. For example, by practicing geographically targeted DR, utilities gain a larger degree of control over the grid, enabling grid-balancing opportunities that can defer transformer and substation maintenance.

Implementing a DR strategy prepares utilities for the future.

In the long term, implementing a DR strategy prepares utilities for the future. Customers are driving the industry toward an automated and optimized grid, and utilities that don't invest in this future may find themselves unable to provide the services customers want and need. Customers are increasingly interested in electric vehicles, smart buildings, and distributed energy resources, and it's in the best interest of utilities to use DR to capitalize on these products and services.

Deferring or avoiding infrastructure upgrades. By implementing targeted DR programs, utilities can defer or avoid infrastructure upgrades. Greentech Media's April 2017 article 3 Examples of How Demand Response Is Morphing as a Grid Resource reports on Central Hudson's targeted DR program. Though Central Hudson's system peak load had been decreasing for a decade, certain feeders were growing. So instead of making expensive infrastructure upgrades, the utility opted for a targeted DR solution that met and exceeded the utility's goals.

Adding DR to your utility's resource mix provides a unique diversification option that you can turn to in the event of an emergency.

Grid-balancing and resource diversification. In addition to giving utilities the ability to balance the grid, DR offers perks akin to those provided by traditional ancillary services such as operating reserves. A DR project between EnerNOC, the Australian Renewable Energy Agency, and the New South Wales government exemplifies these benefits. As described in an October 2017 EnerNOC press release, EnerNOC Awarded 50 Megawatt Demand Response Contract in Australia, the company was contracted to deploy a 50-megawatt DR resource across New South Wales and Victoria. The project was designed to support system reliability and provide frequency control ancillary services with "a sub 1-second fast frequency response to help maintain system stability following unexpected contingency events." Adding DR to your utility's resource mix provides a unique diversification option that you can turn to in the event of an emergency.

DR's customer-centric future

The larger value of DR lies in the future. The ways customers generate, receive, and even pay for power are rapidly changing. We've detailed four such shifts that DR can enable or enhance. By embracing DR now, you can provide and enable the technologies customers want while reaping the benefits of these services to your utility.

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Distributed energy resources (DERs). Customers in both the residential and commercial realm are increasingly interested in DERs and behind-the-meter (BTM) storage. We're seeing more and more microgrid projects and corporate sustainability commitments that involve DERs. Some customers are motivated by the concept of clean energy while others are interested in DERs and BTM from a disaster-mitigation standpoint. DR's inherent flexibility can assist in managing the inevitable variations in power generation from DERs.

Smart homes. With the proliferation of smart home technologies, customer interest in automating and optimizing their energy usage is growing. DR allows utilities to capitalize on this interest to reduce their generation needs. For smart thermostat program best practices, check out our report SCE's 3 Cs of Smart Thermostat Program Success.

Electric vehicles (EVs). The EV market will almost certainly continue to increase customers' demand for energy. DR can help utilities manage this surge, and DR technology can enable pricing plans for EV owners that encourage charging during off-peak times.

Time-based pricing and alternative purchasing mechanisms. DR technology enables utilities to introduce time-based pricing, such as time-of-use rates, critical peak pricing, and dynamic peak pricing. In the future, sensors and controls used for DR could support customer-to-customer electricity sales via blockchain.

Further reading

The Value of Demand Response in a Hydro-Dominated Power Grid&#8212The Example of Québec, Canada (PDF) by Vincent Dufresne addresses the role of hydro-electricity in Québec, which received 99% of its power from this resource. The author emphasizes two main benefits of DR in the region—and others like it:

- Managing increasing loads
- Maximizing economic gains from electricity exports

Designing a Successful Demand Response Program: It's Not Your Grandfather's Load Control Program (PDF) by Carmen Baskette Henrikson and Kristin Brief of EnerNOC, written for an American Council for an Energy-Efficient Economy (ACEEE) Summer Study, explores the program design elements that directly influence the success of commercial DR programs. The report includes a table that suggests program design elements that help meet different DR program goals such as system reliability or peak management, economic goals, and ancillary services. Regarding reliability, the authors note:

> "DR is a capacity resource that can be dispatched to meet many of the same needs as a peaking combustion turbine. Reliable DR is ideally suited to provide operating reserves during peak demand periods as it can be brought on- and off-line quickly for short periods of time throughout the year. In many systems throughout the United States, up to ten percent of system infrastructure is needed for less than one percent of the hours in the year. DR programs can provide demand reductions during the 50 to 100 hours of the year when demand is highest to relieve peak loading and improve system reliability."

The Role of Electric Utility Energy Efficiency Programs in Building Community Resilience (PDF), by Dan

York, Brendon Baatz, and David Ribeiro of ACEEE, explains how DR can play a role in developing community resilience. DR can assist utilities in “planning for a reliable electricity supply with limited disruptions and outages.”

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