

**Demand Side Management:
Why utility-directed load
management programs make
more sense than ever before**



Are you leveraging the benefits
of next generation demand
side management tools?

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Today's electric utilities need to perform a delicate balancing act between the need to meet the dynamic load requirements of their customers and the need to improve energy efficiency and conservation.

In this white paper, we'll look at how — with more detailed information about customer consumption through the deployment of AMI and smart energy response and management technologies — utilities can streamline and target Demand Side Management (DSM) program deployments for a better understanding of customer loads and potential reduction opportunities.

We will demonstrate that, by focusing demand response and energy efficiency resources on load control and distribution grid voltage management programs, utilities can solve their demand management issues with greater certainty, less consumer impact, and no reduction in perceived performance or quality of service.

Defining Demand Side Management

DSM strategies have been used by the industry for many years for managing

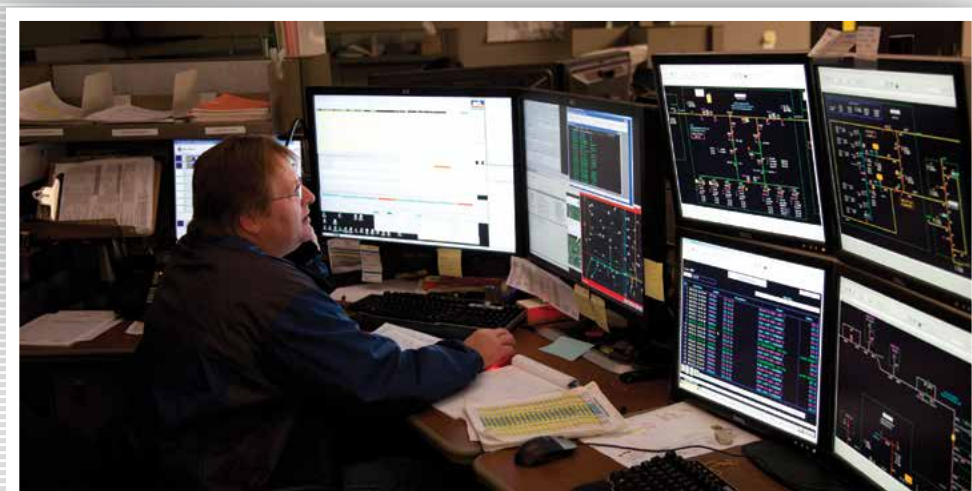
The U.S. Department of Energy defines Demand Side Management as: “Changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.”

mostly large, predictable commercial loads. Supply constraints, caused in large part by the significant costs and political challenges of building new generation — along with rising demand for electricity — are compelling utilities to take a new look at the potential of DSM to play a larger role in better managing the consumption and demands of smaller commercial and residential customers.

Yet, getting past the industry jargon to a clear and focused definition of DSM — and a quantifiable ROI — represents a real challenge for the industry. In current parlance, the term demand side management encompasses a wide range of solutions for reducing, shifting or reallocating energy demand. Often, DSM is used as an umbrella term covering several objectives, including load management and energy efficiency.

According to the North American Electric Reliability Corporation (NERC), demand response is “a subset of the broader category of end-use customer energy solutions known as Demand-Side Management.”¹ Even the Federal Energy Regulatory Commission (FERC) finds that “the rapid evolution of demand response programs, rules and names increases confusion among respondents and staff alike.”¹

FERC lists 14 demand response programs — from direct load control (DLC) to real-time pricing and system peak response transmission tariff. While many of these methods have been tried over the years, utilities have often been stymied in their efforts to make them cost-effective and to employ them as dependable methods for controlling peak energy needs.



¹ NERC, “Assessments & Trends: Key Issues—Demand Response”: <http://www.nerc.com/page.php?cid=4%7C53%7C56>

² Assessment of Demand Response & Advanced Metering, Staff Report, February 2011, page 21

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The Next Generation of DSM

In the past, utility DSM programs relied on incentive options, mechanical switching, or one-way load control transmitters — with unverifiable results. In order to meet urgent needs like peak demand management, grid reliability support and managing energy expense, utilities can now leverage the ability of the next generation of DSM tools to provide greater verifiability, reliability, quality, targeted control and cost savings.

Advanced metering networks provide more granular data about customer usage, system communications and measurement of customer responses.

With the ability to make and verify real-time adjustments to demand, utilities are able to realize significant reductions in the cost of managing supply volatility caused by the growing use of renewable energy sources, distributed energy resources, and electric and hybrid vehicles — while complementing energy conservation efforts.

Advanced metering infrastructure (AMI) and other smart grid technologies offer new ways for utilities to gain the real-time visibility and intelligence they need to monitor and control millions of devices over a wide network.

As the country looks to the future, the need for widespread deployment of next generation DSM technologies becomes obvious. According to a recent report published by the Electric Power

Research Institute (EPRI), the U.S. Energy Information Administration (EIA) projects that U.S. electricity consumption will grow at an annual rate of 1.07 percent, with a cumulative growth of 26 percent by 2030.

In the report, EPRI estimates that summer peak demand in the United States is expected to increase by 39 percent — a faster annual rate than electricity use — and that the combination of demand response and energy efficiency programs has the potential to achieve a reduction of 14 percent to 20 percent by 2030.³ With FERC placing demand response programs on par with energy efficiency⁴, DSM solutions will continue to be a high priority for utilities.

Load Reduction: Dynamic Voltage Management

The use of distribution voltage control for load management is not new. Because U.S. utilities are required to comply with ANSI requirements for voltage variation — a nominal voltage of 120 volts with a +/- 6-volt variance, or 114 to 126 volts at the customer site — utilities have monitored and controlled voltage at substations and some feeder locations for many years. Prior to the introduction of advanced residential meters, gaining real-time visibility into voltage levels beyond the substation was simply not practical.

As a result of this lack of visibility, utilities have typically maintained customer voltage at a higher level to prevent end-of-line locations from falling below 114 volts. As cumulative load or distance along a circuit increases, voltage begins to diminish on distribution feeder lines. To make up for this loss, utilities typically raise the level of voltage to customers at the beginning of the circuit.



However, this practice can create significant line losses and inefficient equipment loading. Clearly, there is a need for a solution that enables utilities to deliver fully optimized voltage regulation in real time over the entire length of the distribution circuit from the substation to the customer premise.

Dynamic voltage management, or adaptive voltage control, is a DSM solution that offers substantial opportunities for utilities to lower net energy consumption by customers and reduce distribution losses between the distribution feeder and the customer site. When you consider that distribution line losses represent approximately 5 percent of total electricity generation — or as much as 8 percent in peak load conditions⁵ — plus the ability for customers to reduce their energy consumption or peak load demand by another 2–4 or 1–3 percent respectively, voltage control can reap significant savings to both utilities and their customers.

³ Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S.: 2010-2030 EPRI http://www.edisonfoundation.net/ee/reports/EPRI_SummaryAssessmentAchievableEEPotential0109.pdf

⁴ "FERC to require equal compensation for demand response," March 24, 2011: <http://ase.org/efficiencynews/ferc-require-equal-compensation-demand-response>

⁵ "Impacts of Smart Grid Technologies on Residential Energy Efficiency," ©2010 ACEEE Summer Study on Energy Efficiency in Buildings," page 9: <http://eec.ucdavis.edu/ACEEE/2010/data/papers/2219.pdf>

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Monitoring and controlling voltage at the customer level requires an advanced metering system that can collect voltage information at customer sites and provide mechanisms for alerts and feedback. Smart grid technologies are now available that provide robust sensing, analytics, communications and business logic. With these new technologies, utilities can now have near-real-time data about the energy being consumed at any point on the distribution network, as well as information about power quality — including voltage — and much more.

With the ability to use timely voltage data from every meter and to integrate this information with SCADA systems, voltage regulators with automated switches, and other distribution devices, voltage management applications enable utilities to monitor and tightly control voltage levels along a distribution circuit with greater precision than ever before. This, in turn, enables the utility to reduce customer voltage while keeping it within specification, to distribute energy more efficiently and provide peak load reduction or off-peak energy conservation, whichever provides the greatest benefit to a utility.

Reducing voltage on feeder lines that run from substations to customer sites by 1 volt can yield up to 1.2 percent savings in total load. Reducing voltage from 120 volts to 118, for example, could reduce the power a utility delivers by nearly 2 percent — a gain that could add up to gigawatt-hours of energy savings over a single year.

Until now, the main challenges that utilities face when taking steps to implement a dynamic voltage management program are the development of a clear and practical method for:

- Collecting voltage readings at every consumer premise point of the distribution system (e.g., meter)
- Controlling voltage that is adaptive to the dynamic changes that typical distribution circuits undergo
- Measuring the energy saved when the circuit is operating in the more precise lower or upper voltage band

By combining the most recently developed advanced metering technology, automated distribution devices and an operational statistical measuring technique, dynamic voltage management solutions accomplish these objectives.

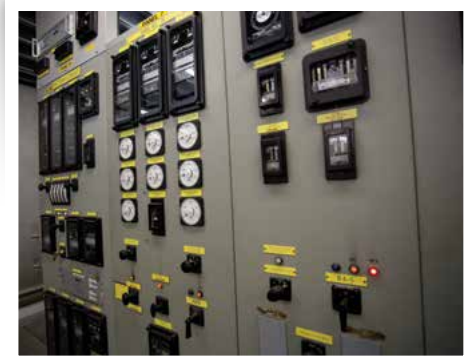
Peak Load Management: Direct Load Control

For many years, utilities have been using Direct Load Control (DLC) to unilaterally shed remote customer loads and to provide critical peak load reduction.

The largest category of DSM solutions, DLC accounts for approximately 17 percent of the national peak reduction potential reported in 2010. By reducing the need for generation capacity and energy purchased on the open market during peak demand periods, load control provides significant cost savings for utilities and their customers.

Historically, DLC programs were designed primarily for use in emergency conditions or to help offset the costs of providing power during peak hours. These programs commonly relied on one-way radio or paging devices that provided no feedback on operations.

DLC programs usually cover central air conditioning and electric hot water heaters — which account for 70 percent of peak load in the United States — with voluntary



With a DLC program in place, a utility can control HVAC systems, water heaters and pool pumps, and realize approximately 1 to 3 kW of demand response capacity per participant.

participation by commercial and residential customers who are offered incentives such as monthly bill credits or pay-per-event compensation. Participants allow the utility to directly control their devices with little or no ability to opt out of a load control event.

Adding 10,000 participants to a load control program can result in about 20 MWs of annual dispatchable demand response capacity.

However useful DLC programs have been in the past for dispatching loads, new technologies enable better scheduling and verification of these operations. New smart grid technologies offer two-way communications that enable signaling to load controllers, addressability down to the device level, and monitoring and verification capabilities to ensure proper connectivity and performance — capabilities that utilities need to deliver the next generation of DLC.

⁶ "120 to 118? Will Dropping Our Voltage Save Power?," greentechmedia.com: <http://www.greentechmedia.com/articles/read/120-to-118-will-dropping-our-voltage-save-power/>
⁷ "MIT Study on the Future of the Electric Grid, Chapter 7: Engaging Electricity Demand," page 152.
⁸ Ibid.

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Feedback from devices, along with interval data from advanced meters, provides assurance that the load control devices are operating and helps quantify the actual load shed during each event. Two-way technologies also provide for flexible and adjustable scheduling—providing for the first time a tactical tool for distribution grid operators to control peak load occurring at substations and/or feeders. And operations are transparent to customers, so there is no impact on lifestyle or need for changes in behavior.

Utilities now need much more accurate data about the peak load reduction being

achieved by their DLC programs. Because some DLC program participants contribute more than others during typical load reduction events, utilities can use these data to determine the optimal control strategy for each customer device. And, with more and more independent system operators (ISOs) demanding more accurate estimates, utilities need access to detailed energy usage data—ideally, through an advanced metering system rather than more costly field collection or less accurate estimation processes.

Conclusion

By integrating next generation smart grid technologies into current voltage management, load control, and energy efficiency programs, utilities can realize significant savings by reliably flattening peak demand, thereby reducing the need for more generation capacity and lower peak power costs. Of course, the added information provides operational benefits that extend to proper equipment sizing, preventive maintenance, and a better understanding of system load beyond the substation. Consumers, too, benefit from these programs in associated cost savings from reduced energy consumption and power quality improvements.

