Cost-Effective Actions to Reduce Peak Loads

Many electric utilities offer various types of voluntary demand response (DR) programs for their industrial customers. There are several benefits of participating in demand response programs and managing your facility's load shape on an ongoing basis. In addition to the direct payments or incentives from the utility for participation in DR programs, a smoother load shape can save you money in two other ways: For customers in states that allow a choice of retail electricity providers, it will significantly lower the facility's overall electricity rate by reducing the utility's cost to provide power. For companies in regulated states, it will reduce the facility's peak demand and other capacity charges.

Demand Response Program Basics

In voluntary "pay-for-performance" programs (also sometimes known as "buy-back" programs), the utility notifies customers, normally a day in advance of the curtailment period, of specific price incentives it will offer to reduce load during this period. The customer chooses whether to participate, and the utility monitors the facility's changes in electricity consumption during the curtailment period to determine the incentives to be paid (referred to as "settlement"). By developing a load curtailment plan, your facility can earn significant payments from the utility for participation in this type of program, making it well worth your time and effort.

There are simpler types of DR programs, such as time-of-use rates, in which load management is more of a routine or daily activity. There are also more sophisticated DR programs, such as real-time pricing and demand-bidding programs, which require advanced meters and more detailed and timely energy usage information. In this pamphlet, we focus on the very common pay-for-performance programs, but most of the energy management opportunities highlighted here would also apply to the other types of DR programs.

Most electric utilities in the United States already have meters in place to collect hourly usage data from their large commercial and industrial customers, and they will provide this data to DR program participants. (If no interval meter is in place, utilities will often pay all or part of the costs to have one installed.) This detailed energy usage information can help you find opportunities to improve your facility's load profile and overall energy usage. It can also help you find opportunities to further reduce loads on short notice, so that you can participate in load curtailment events. In addition, more detailed energy information will often reveal opportunities to reduce a facility's overall energy use.

Choosing to Participate in a DR Program

The decision to participate in a demand response program is driven primarily by economics: whether the benefits are greater than the costs. Financial benefits of participation include both outright payment and ordinary savings in energy and demand charges. Payments may vary widely and can come from multiple sources, including the electric service provider, the grid operator, and other intermediaries or government agencies. Participation costs may include equipment upgrades and modifications, electricity usage metering, data monitoring and analysis, controls and sensors, personnel costs, and potential reductions in product output.

Facilities in which one or more of the following conditions apply could be prime candidates for DR:

- Peak electric demands are high
- There is exposure to fluctuating spot market electric prices
- Interval meters are installed or can be readily installed

- There is a champion for energy management and demand response at the facility
- Options are available to reduce demand for a few hours (such as increasing production before and after the curtailment event or slowing down processes during the event)
- There is flexibility in the scheduling of certain production processes
- Backup generation capacity is available that can operate in nonemergency conditions

Designing a Curtailment Plan

Once a facility decides to join a DR program, it must consider what curtailment actions to take. These actions can vary from event to event, but it makes sense to develop a specific curtailment plan describing the range of options, the expected demand reductions, and how those reductions will be implemented. Many energy service providers offer assistance in identifying opportunities and developing a curtailment plan. The plan can then be implemented during the curtailment event—either manually by the facility management staff or automatically using an energy management system.

General Types of Load Reduction Practices

Common facility management practices include turning off specific lights or light circuits, changing thermostat settings on space-conditioning systems to reduce operating times, cycling or curbing ventilation fans, and shifting cleaning and maintenance crews to off-peak hours. These are relatively low-risk options.

The larger opportunities and benefits, as well as the larger risks, are with changes to production processes. Some of the measures we describe in this pamphlet are appropriate for ongoing peak reduction or load leveling, while others measures are appropriate for more drastic and temporary load reduction, as in pay-for-performance DR programs. Medium-risk options include slowing down processes, taking advantage of storage capabilities, and running standby generation equipment. Higher-risk options include stopping the processes and shifting production to earlier or later periods. However, even some of these more dramatic production changes can be accommodated readily with good planning and management.

Uncovering the Causes of Demand Spikes

To help increase participation in its peak load management program, Connecticut Light and Power (CL&P), with the help of an energy service company, conducted a series of audits for industrial customers during the spring and summer of 2000. The preliminary assessment of load profile data for an Acme textile facility showed that the demand at the facility was extremely variable on weekdays, with several peaks and valleys occurring throughout the day. Further analysis showed that 95 percent of the time, the facility's demand was less than 1,360 kilowatts (kW); if the demand could be kept below that level for the remaining 5 percent of the time, Acme would save $31,000 per year.

To identify the source of the peak demand, the consultants installed temporary submeters at strategic points throughout Acme's facility. Acme and the consultants then agreed on a plan to spend $25,000 to install an energy management system (EMS) that would control 12 main energy loads. The new EMS enabled the facility staff to continuously monitor the main and ancillary loads to stay under the 1,360-kW demand cap, and the payback period for the investment was only 10 months. Because the EMS can be programmed to automatically reduce the facility's load according to agreed-upon actions, the EMS also enables the facility to better participate in CL&P's demand response programs, providing additional energy cost savings.

Scheduling and Storage

Minor shifts in the scheduling of operations can make a big difference in peak demands. For example, it may be possible to stockpile materials for processing during off-peak periods. Operations with built-in liquid storage capacity can also have excellent opportunities for demand response. In some fluid systems, pumping is activated when the fluids reach a set level, so as long as

sufficient storage capacity is built up ahead of the curtailment period, the pumping action can be postponed until after the curtailment period is over. For example, a semiconductor plant deionizes water and stores it until it is needed in the manufacturing process. During curtailment, the plant stops two of the three pumps in the deionizing process. By filling the tanks prior to curtailment, the plant is able to keep operating while drawing down the reservoir.

Crushing operations in cement plants are good candidates for demand response. For example, one cement plant operates three rock-crushers simultaneously. During curtailment events, the crushers are rescheduled sequentially to maintain some production while drawing on the inventory of crushed material for the remainder of the process. In plants that have variable-frequency drives in place, motors for the crushers may be scaled back, or the motors may be turned off completely.

Wastewater treatment plants are able to participate by managing aerator processes. One practice is to reduce motor speeds for pumps and other aerator equipment; another is to turn off the aerators altogether. A third option is to sequence multiple aerators so that at least one is operating on a rotating basis. In most cases, it will be necessary to extend aeration times. The whole process can also be managed remotely through automatic control systems.

Process Cooling

Plants with heavy refrigeration loads can reduce peak demand by cooling the refrigerators to a lower temperature prior to the curtailment period and then coasting for a few hours. For example, when a load curtailment is called for, a fish-processing facility precools from 40° to 33° Fahrenheit (F) in the morning and then coasts through the afternoon. In addition, it keeps fish on ice in storage or in boats, where feasible, until after the curtailment to reduce demands on the refrigeration system. A beverage warehouse precools and saves 200 kW on peak. A frozen-food manufacturer precools its freezers at 10° to 15°F below its normal 0°F, depending on how long the curtailment period is forecast to run.

Flash-freezing and finishing of food products can also be reduced or postponed until after the curtailment period is over. Depending on the amount, temperature, and perishability of the food, it may be stored for later processing.

Blending, Milling, and Mixing

Milling, mixing, and blending operations are common in food processing, pharmaceutical manufacturing, and chemical production. These processes may be slowed or stopped using manual or automated systems. New control technologies are being developed to optimize product quality and to reduce energy use at the same time. For example, a new control technology relying on optical sensors is being tested by the New York State Energy Research and Development Authority. Optical sensors using infrared lighting compare product quality against the "fingerprint" of the optimal quality for the product. When the product reaches the optimal condition, the process is stopped and energy is saved from unnecessary mixing and milling.

The advantage of optical sensors for DR is that certain batch processes can be stopped on short notice and started again automatically after the curtailment event, with stronger assurance that the desired mixture will be accurate. For processes that require worker presence upon completion of the process, the step can be reactivated in the middle of the night so that it finishes as the day shift begins. Processes benefiting from this technology include those producing food products, cosmetics, paints, inks, organic chemicals, and inorganic chemicals.

In grain-handling operations, aeration fans can be run at night (when temperatures are cooler) rather than during peak periods. Peak demand savings can also be

achieved by turning processing equipment off for the few hours of the curtailment period, except perhaps on days when harvesting is at its peak. Operations can be resumed during off-peak hours to make up for lost production time.

Standby Generators and Other Auxiliary Equipment

On average, about 70 percent of the industrial and large commercial customers participating in demand response programs have emergency generators, and about 40 percent of them call upon their backup generators for curtailment events. Some companies that have emergency generators are constrained by air-emissions permits that allow emergency operation only, and some companies may assume that backup generators are only for emergency use. However, many companies are successfully extending their permits to allow for participation in demand response programs. Frequent use of emergency generators improves the reliability of the generators during actual emergency events.

For Further Information

- California Energy Commission, "Peak Load Reduction Fact Sheets," www.energy.co.gov.
- ISO New England, "Am I a Good Candidate for Demand Response?" www.iso-ne.com.