Want to Avoid Building a Large Power Plant? Top Ten Keys to (or "Attributes of") a Successful Demand Response Programs

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ABSTRACT

In the Summer of 2006, regions throughout the US experienced new highs in peak demand. In fact, many regions reached demand levels that were not forecasted to occur for several more years. Yet some power systems were able to meet this tough challenge to successfully manage their grid under extreme stress more effectively than others because they had well-designed demand response programs. How can utilities optimize the performance of their demand response programs to best meet future peak demand needs? In 2005-06, Xcel Energy hired PA Consulting Group to conduct a process evaluation of their Minnesota Commercial and Industrial (C&I) Peak Load Control Program, a customer-driven demand reduction program. This paper highlights the results of this evaluation to provide "Top Ten" considerations for effective demand response programs.

Introduction

In the Summer of 2006, regions throughout the US experienced new highs in peak demand. In fact, many regions reached demand levels that were not forecasted to occur for several more years. Yet some power systems were able to meet this tough challenge to successfully manage their grid under extreme stress more effectively than others because they had well-designed demand response programs. With few power plants being sited each year, the number and variety of demand response programs now offered by utilities to manage peak demand has dramatically increased over the past decade and covers all regions of the US[1].

There are many variations of demand response programs but the three most prevalent types of incentive-based demand response programs include:

1. **Customer-driven demand reduction**. These are programs where notification is received from the utility and it is up to the customer to reduce load, typically for a financial incentive. This type of voluntary program only pays credits to the customer for reducing load when requested.
2. **Direct load control**. These are programs where a utility turns off and on specific equipment, normally air conditioners.
3. **Interruptible/Curtailable**. In these programs, the utility provides discounted/reduced rates to the customer if they reduce demand when directed. , Participants sign contracts and agree to reduce load when requested and typically receive credits all year and pay penalties for non-compliance.

Customer-driven demand and interruptible/curtailable reduction programs represent the majority of Commercial and Industrial (C&I) demand response programs offered by utilities.

While US utilities were able to avoid blackouts in the Summer of 2006, wholesale power prices did rise above price caps set by federal regulators in several regions, making it more difficult for grid

[1] EEnergy Informer, September 2005, p. 10

operators to obtain enough electricity. With peak demand projected to continue to grow in the next several years, and new power plants being costly and difficult to build, demand response programs will continue to be a necessary element of any successful strategy to cost-effectively meet demand requirements.

Are there common design parameters or other institutional factors that are correlated with high performance demand response? We define high performance as demand response programs that cost-effectively provide reliable load relief during control events. In 2005-06, Xcel Energy hired PA Consulting Group (PA) to conduct a process evaluation of their Minnesota Commercial and Industrial (C&I) Peak Load Control Program, a customer-driven demand reduction program. First, we introduce Xcel Energy's C&I Peak Load Control Program (the Program) followed by the process evaluation methodology. Then we present "Top Ten" considerations for effective demand response programs based on this evaluation and other recently conducted evaluations of demand response programs.

Program Description

The Commercial and Industrial (C&I) Peak Control Program is one of Xcel Energy's "peak reduction" programs. These programs instruct customers to use less power at high-demand times and to shift power usage to off-peak times, which allows Xcel Energy to reduce peak demand and spread electric use more evenly. This "peak reduction" and "load shifting" means the Company can operate its plants more efficiently and can pass the cost savings on to its customers.

Xcel Energy has offered the Peak Control Program to its Minnesota Commercial and Industrial customers for over fifteen years. More than 2,000 premises in Minnesota participate in the Program. It is described by program staff as a "mature program." Current customer recruiting efforts are limited to replacing customers who leave the Program in order to maintain the same level of interruptible load (approximately 540 MW) available to Xcel Energy on peak control days in Minnesota.

Program Criteria

Eligible customers must have the capability of curtailing load of at least 50 kW during the summer months and also may not be a participant in the Saver's Switch for Business program (a direct load control program for HVAC equipment). Prior to joining this voluntary program, customers work with a Company Account Manager to identify how much load they can control and how many hours they can support control at their facility. The data is then used to calculate a pre-determined demand level (PDL) of kW during peak demand periods. The PDL represents the maximum amount of demand (kW) the customer may have on the system during a control period. All demand above the PDL is considered interruptible and the customer receives a credit for each kW of load above the PDL every month. During a control period, demand measured above the PDL is considered a violation and the customer is penalized and returns a portion of the credit.

The customer chooses or selects the PDL, and the maximum number of hours they are willing to control each year. There are two options or tiers available for participation:

- Tier 1 customers can be controlled up to 150 hours a year and sign a 10-year contract that requires a 3-year cancellation notice.
- Tier 2 customers can be controlled up to 80 hours a year and sign a 5-year contract that requires a 6-month cancellation notice.

Program Attributes

As stated above, in return for participating, customers receive year-round discounts on their demand charges. The credit is a fixed discount off their normal monthly peak charge. Participants have the opportunity to save as much as 60% on their monthly demand charges if they are able to reduce demand for electric power to their PDL during the Company's peak demand periods. The more load a customer is able to control, the greater his bill credit. The discount amount depends on the number of controllable hours and kW reduction the customer agrees to; Tier 1 customers receive a larger discount than Tier 2 customers.

Control periods generally occur on hot, humid summer days between June 1 and September 30, but may occur during any season in a system emergency. The Company uses a system to automatically send messages notifying customers via e-mail, text and/or phone when they need to reduce. A one-hour notice is attempted, but not guaranteed.

Marketing Activities/Goals

Each spring customer meetings are held to inform participants of any program changes, review what is expected from customers on control days and discuss the benefits to customers of participating in the Program. Account managers play a key role in the recruitment of new customers to the Program. Each year account managers receive personal goals for the amount of kW they need to recruit for the Program. Xcel Energy's Business Services Center (BSC) also plays an integral part in customer recruitment. The BSC's program recruitment is responsive, when a customer calls the BSC, as opposed to Account Managers who actively target customers.

Program Changes/Growth

Staff members noted the following major changes have been made to the Program since its inception:

- Managers changed the program credit so that it is not the same for all participants. Now the customer credit recognizes customers who provide most of their controllable load during the summer season when it is needed the most.
- Improved the notification process using an automated system (Envoy) that makes the customer more accountable for ensuring they receive notice of control events.
- Subdivided control groups into smaller 50 to 75 MW blocks to provide greater flexibility and control.

At this time, the Xcel Energy Peak Load Control Program's objectives are to replace lost load control resulting from customers who drop out of the Program each year (the Program experiences approximately 1% attrition annually). However, each year, Xcel Energy has seen new record peaks each summer in Minnesota. Xcel Energy is forecasting continued growth that will lead to the need for new generation and increased use of conservation and load management programs. Therefore, the Program may need to look at avenues for growth in the next few years.

Evaluation Methodology

The overall goal of the process evaluation was to assess Xcel Energy's Peak Load Control Program's operations and configurations to identify opportunities to improve the Program. The evaluation's primary objectives were first defined in the RFP and then further refined and prioritized at the start-up meeting, In order of importance, these objectives included:

- Identify the most attractive target populations for the Program.
- Identify back-up generator penetration, activity, and fuel type.
- Determine the extent to which customers can be reasonably controlled beyond the current program configurations.
- Gauge the impact of alternative interruptible design elements on program participation.
- Identify areas where program implementation can be improved.
- Gauge program participant satisfaction.
- Describe the features of peak control programs implemented at other utilities.
- Understand how utilities with similar peak control programs are responding to issues potentially impacting their programs.

PA's evaluation team conducted a comprehensive data collection and analysis effort to accurately describe the Program's processes, identify areas where the Program is operating optimally, and develop concrete and actionable recommendations for areas where improvements are needed. PA's methodology involved multiple tasks:

- Task 1: Start-up meeting and evaluation plan
- Task 2: Interviews with 19 Xcel Energy program staff to frame the process issues, understand the Program's operations, support the survey sampling strategy, and begin to identify areas for improvement.
- Task 3: Participant surveys to obtain process-related and program configuration data from customers by completing 300 participant telephone surveys. The surveys were conducted in November 2005. The participant survey was designed to obtain feedback on:
    - The most attractive target populations for the Program
    - Areas where program implementation can be improved
    - Program participant satisfaction—likelihood of continuing participation
    - Back-up generator penetration, activity, and fuel type
    - Actions taken to respond (reduce load) on Control days
    - The impact of alternative interruptible design elements on participation
    - Role/effectiveness of the participant's designated contact person
    - The extent to which customers can be reasonably controlled beyond the current program configuration
    - Characteristics of the businesses

  The participant survey was stratified by Tier and achieved a 74% response rate. This high response rate helps ensure the survey results are representative of all program participants.

- Task 4: Drop-out surveys that interviewed 18 former participants. These surveys addressed many of the same issues as the participant surveys but also examined reasons why these customers left the Program, and the barriers to future participation.
- Task 5: A best practices study collected process-related information on 17 similar utility peak load control programs. The research was supplemented with in-depth interviews with program managers for six of the Programs of most interest to Xcel Energy. The objective was to identify, describe, compare, and contrast the key features of similar peak control load management programs currently being offered by other utilities to understand how these other utilities are responding to issues impacting their programs.
- Task 6: Load Research and Secondary Data Analysis examined the most attractive populations for the Xcel Energy Program, through analyzing participant load research data provided by Xcel Energy for two control days when all control groups were called. The data analyzed by customer sector included the actual load, predicted load, and pre-determined level (PDL) for each customer for the control day. The load research data for each customer was matched with Dun and Bradstreet data provided by Xcel Energy that contained business type and other firmographics. This task resulted in identifying those customers sectors that are "solid performers" for the program and those that are "poor performers". Based on this task, the sectors found to be high performers are:
    - Manufacturing that includes: Paper Products, Chemicals, Primary Metal Industries, Lumber and Wood Products, and Rubber and Miscellaneous Plastics.
    - FIRE (Finance, Insurance, Real Estate): Real Estate makes up almost half of FIRE sector participants and includes non-commercial building and apartment building operators and managers in addition to real estate agents and managers
    - Trade. Wholesale Trades comprises the majority of this sector. Grocery stores and various retail stores also fall within this category
    - Other Services. Contains social services (primarily day care facilities), business services, engineering/accounting/research management, and lodging.
    - Health includes hospitals
- The sectors found to be poor performers are:
    - Membership Services, mostly religious organizations.
    - Recreation that includes Miscellaneous Amusement/Recreation Services such as health clubs and golf courses.

Top Ten Keys to (or "Attributes of") a Successful Demand Response Programs from Evaluation Results

Based on the results of the process evaluation of Xcel Energy's Peak Load Control Program, the results of the best practices study of 17 other utility demand response programs conducted to support the Xcel Energy process evaluation, and the results of a process evaluation PA recently completed for a Northeast utility, we have identified the following top ten key, or attributes of, successful demand

response programs. Again, we define successful as demand response programs that provide cost-effective and reliable load relief during control events.

1. Clearly establish goals and objectives for the program. In some cases, the program is designed to play a critical role in managing the system peak. Other programs may target areas on the distribution system to delay major new construction. Still other programs may serve as pilots or as a resource to allow customers to manage their loads when electric costs are at their highest. The program goals must be well-defined and clearly communicated to all staff to ensure an appropriate level of program promotion and recruiting of customers to the program.

2. Target, and limit, program recruitment to those customers who are solid performers. Program management should take into account the "market attractiveness" of various customer sectors to identify targets for demand response programs that fit with the overall objectives of their program. Analysis of a combination of customer survey and load data for participating customers should be conducted to identify solid performing customer groups. The following are examples of factors that may be used to rank order customer sectors in terms of attractiveness:

- **Compliance:** the percent of participants in the sector who respond most effectively when asked to reduce load during a control event including the level of compliance compared to any pre-established thresholds
- **Rationality:** the percent of participants in the sector that set realistic levels below their typical load such that they are achievable targets
- **Average and Total Controlled Load Per Hour:** the amount of load response per hour for the control period
- **Payback:** the amount of the load reduced during the control period that was replaced in the period before or after the control period.

Once solid performers are identified among existing participants, these same types of customers can be targeted by program recruitment efforts when the program needs to expand or replace lost load relief.

In determining which customers are the most and least attractive, it is important to understand how they operate and what actions they take or can take to respond to a request to reduce load. For example, customer segments who typically use backup generators may be attractive. Other factors influencing performance need to be researched and understood. Types of other factors include the commitment of facility staff, the type of HVAC and control equipment they have, and the customer's ability to shift load.

Once attractive and unattractive customer segments are identified, the program should be designed to eliminate poor performers by effective target marketing, careful monitoring of customer response, establishment of minimum capabilities for curtailing load, and carefully crafted contract terms and conditions.

3. Provide an effective process to notify customers of a control event. Programs typically provide multiple venues to customers for receiving control day notifications including telephone calls, and email, fax and/or pager notices. One evaluation PA conducted of a demand response program in the Northeast found that customers would be interested in an 'energy orb' that would glow a certain color during a control event. In addition, it was found that it is important to structure the notification process to get a response from the customer acknowledging they received notification. The evaluation of Xcel Energy's C&I Peak Load Control Program found that compliance is greatly increased if more than one person at a customer site has been trained to respond to a control event. The competitive intelligence study conducted for Xcel Energy found the length of advance notice regarding a control event ranges across utility programs from 30 minutes to one-day notification. Most utilities provide at least one-hour notification. Some utilities offer programs that tailor the program incentive based on the amount of notification the customer is willing to accept as well as the amount they are able to curtail.

4. Assist customers to help identify ways to respond to control events that fit their operations. To the extent possible, programs should identify ways for individual customers to respond to control day events that do not negatively impact their business. Providing this type of technical support will increase participant compliance, satisfaction and retention. One program offered a demand response audit conducted by experienced contractors. This audit helped customers define site-specific strategies for reducing demand at times of local or regional peak load based on their equipment and operations. The costs of the technical assistance can be reduced by coordinating demand response audits with energy efficiency programs to identify opportunities for both types of programs while on-site.

5.**Make sure participants' compensation is in-line with the value they provide to the company.** Demand response programs often pay incentives to customers that are linked to the amount of load the customer curtails and electric market prices. Other programs provide a base or "retainer" credit for participation such as a demand discount and then a second incentive payment that is tied to the amount that the customer reduces their load during a control event. Most non-voluntary demand response programs also have penalties for control event non-compliance. While it is important that compensation is set at a level to encourage participation, it is also important to analyze the costs and benefits to ensure the program is not overpaying for interruptible load under the current market conditions.

6. **Take advantage of internet tools to increase program participation and compliance.** Internet-based systems can allow customers to monitor their consumption. While there are resource costs to get the system set up, train the customer to use the system, maintain, and test the system, utilities interviewed for the evaluation's assessment of "best practices" of demand response programs that was part of the Competitive Intelligence task indicated that the internet-based systems have resulted in increased compliance and satisfaction.

7. **Configure interruptible loads to allow the program administrator the flexibility it needs to best meet peak demands.** Programs can be designed to have different configurations that provide a certain amount of interruptible lock (the amount of load that can be controlled). If smaller groups are configured (such as 50 MW groups), this allows the utility, state, or ISO more flexibility in obtaining the correct amount of demand reduction while reducing the number of times that each customer is asked to respond to control events.

8. Introduce customers to the concept of demand response programs through voluntary programs – 'good fits' can then graduate to higher reward, higher commitment programs. Voluntary load reduction programs have the potential to deliver load relief and recruit sufficient numbers of customers. Voluntary programs request that customers curtail their load at critical times and provide incentives for the curtailed load, but they do not penalize customers if they do not curtail. It was found that these programs meet their load objectives and recruit sufficient new customers when needed to maintain a base of load that can be curtailed. Customers who have started in voluntary programs, have graduated to non-voluntary programs once they have discovered they are a good fit for demand response programs.

9. Identify specific opportunities to cross-sell demand response programs with energy efficiency programs. Demand response program participants are a potential market for energy efficiency programs. In the evaluation of Xcel Energy's Peak Load Control Program, PA found only a third of demand response participants reported participating in an energy efficiency program. And most of these participants participated in an energy efficiency program *after* they were already participating in a demand response program. Therefore, energy efficiency programs can be actively marketed to demand response program participants and vice-versa. One way to do this is through on-site audits that address demand response and energy-efficiency opportunities at the same time as discussed above.

While most utilities are not currently expanding their demand response programs, they are planning to maintain them as part of their portfolio to successfully manage electric load. That leads to the final key to a successful program:

10, Conduct periodic evaluations of the program by an independent evaluator. In light of the increasing importance of demand response programs to the successful management of the grid, it is important that they are periodically reviewed, preferably by outside experts in program evaluation, to ensure they are designed and implemented as effectively as possible. An evaluator can a program administrator assess the program in the context of "best practices" and performance relative to other successful demand response programs.

Conclusion

With recent unprecedented demand levels, demand response programs are a valuable tool in utilities' program portfolios. At the same time, it is important that demand response programs recruit and maintain 'solid performers' and weed out 'poor performers.' This will help ensure successful demand response programs – programs that provide reliable, cost-effective load relief during peak times. In addition to targeting the most attractive customer segments, there are ways for utilities to help participants become better performers. These include effective notification systems, online tools that allow customers to monitor and adjust their load, and customer education to help customers identify ways their facility can best respond to control events.