Demand Response Enabling Technologies and Case Studies from the NYSERDA Peak Load Reduction Program

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ABSTRACT

The NYSERDA Peak Load Reduction program is an innovative initiative that is intended to serve as a focused demand response or kW reduction enabling equipment installation incentive program, thereby supporting the New York Independent System Operator (NYISO) curtailment programs. This paper first describes both the NYSERDA and NYISO programs, clearly articulating how these programs differ and how they work together. There are multiple options and initiatives available to participants in both organizations' programs, and the benefits or penalties of each option are thoroughly described.

For the NYSERDA program, the key objective is to subsidize the installation of demand response enabling technologies. Following the program discussion, the paper will provide an overview discussion of the multitude of technologies that are appropriate for demand response. The appropriateness and limitations of different technologies for different purposes or programmatic objectives will be described. Key technology categories that will be included in our discussion are: online and real time energy and demand information and reporting systems; direct load control technologies; metering systems; energy efficiency technologies; comprehensive building automation systems; demand-focused control systems; lighting control technologies; emergency generator systems; distributed generation systems; and load shifting equipment.

After the discussion of the enabling technologies, we conclude the paper with a discussion of several NYSERDA case study projects from the Peak Load Reduction Program. These case studies will describe the technologies and approaches deployed to achieve the demand reduction at the site, the quantitative impact of the project, and a discussion of the overall successes at each site.

NYSERDA's Peak Load Reduction Program

The objective of NYSERDA Peak Load Reduction Program (the Program) is to improve electric system reliability and system load factor, as well as reduce electric costs by providing incentives that result in system coincident electric summer peak demand reduction in New York State, particularly in New York City, where there are serious capacity constraints. Incentives are offered to develop and implement peak load reduction project(s) that meet this objective. Measures installed under the program must perform as an integrated function without compromising applicable building code requirements or occupant health, comfort, or safety. The customer baseline load profile and strategy for accomplishing peak load reductions must be clearly delineated in a Technical Assessment report. This report must be provided by the participant facility or the contractor they are working with on the demand reduction effort. The integrated program consists of four components:

- **Permanent Demand Reduction Efforts (PDRE)** result in reduced peak demand during the Summer Peak Demand Reduction Period, through the installation of equipment that provides long-term (expected to be in place and operational for at least five years), overall system coincident peak demand reduction. The program or initiative is not intended to address capital improvements requiring design and installation periods greater than 8 months, for which NYSERDA offers other appropriately focused programs.
- **Load Curtailment/Shifting (LC/S)** results in reduced peak demand either in response to an electric capacity shortfall or defined price signal. In order to participate in this NYSERDA initiative, a Facility must also register in a New York Independent System Operator (NYISO) Demand Response Program (DRP), an Acceptable Load Serving Entity (LSE) Load Management Program, or a Time of Use (TOU) or Real Time Pricing (RTP) Program for at least one entire Summer Peak Demand Reduction Period.
- **Dispatchable Emergency Generator Initiatives (DEGI)** result in reduced peak demand at times of capacity shortfall, by enabling owners of existing emergency/backup generators in the Consolidated Edison of New York service territory to offload all, or a percentage of their electric capacity requirements to their own generators, in response to a communication from the New York Independent System Operator's Demand Response Program (EDRP or ICAP/SCR), or a Transmission Owner Load Management Program for at least one entire Summer Peak Demand Reduction Period.
- **Interval Meters (IM)**, which facilitate determination of demand reduction successes, are necessary for participation in load reduction programs such as the NYISO's Demand Response programs, and/or an Acceptable LSE Load Management Program, including a TOU or RTP program for at least one entire Summer Peak Demand Reduction Period.

Program Incentives

Three types of incentives are available through the NYSERDA Peak Load Reduction Program: a reimbursement incentive, an aggregation incentive, and a controllable appliance aggregation incentive pilot. There are incentive caps applicable to the program, as follows: (a.) Unless otherwise approved by NYSERDA, the total incentive per Contractor under the Program will not exceed 20% of the total funding for this solicitation (initial Contractor cap - $2.1 million), excluding the Aggregation Incentive and the Controllable Appliance Aggregation Incentive Pilot; (b.) The total incentive per Facility for measures under the Program will not exceed 7% of the total funding for this solicitation (initial Facility cap - $735,000); (c.) Contractor and/or Facility caps can be adjusted based on program activity and funding resources; and (d.) The total incentive for the DEGI component of the Program will not exceed 30% of the total funding of this solicitation (initial DEGI cap - $3.15 million).

Table 1. NYSERDA Peak Load Reduction Program Incentive Table

PDRE		LC/S		DEGI	IM	
Con Edison Service Territory	Non-Con Edison Service Territory	Con Edison Service Territory	Non-Con Edison Service Territory	Con Edison Service Territory only	Statewide PSC Approved	Statewide NYISO Compliant
$475/kW	$225/kW	$175/kW	$45/kW	$125/kW	$2500 per meter	$1200 per meter

The incentive for a project is the lesser of 70% of the eligible project costs or the incentive caps set forth in Table 1. Further, the facility owner/operator must contribute no less than 30% of eligible project costs and take ownership of all measures funded under the Program. Ineligible project costs include, facility staff labor, or ongoing expenses such as subscription fees, software licensing fees, service/maintenance fees, communications or internet fees, etc. that might be associated with the project. No more than 30% of the eligible project costs can be for project development. Project development includes administrative costs, overhead, engineering, marketing, development of a technical assessment report, travel expenses, profit, and other related expenses. Further, no less than 70% of the eligible project costs can be for project implementation, which includes only direct expenses for the purchase and installation (labor and material costs) of equipment at the facility, such as on-site operation and maintenance improvements, energy management system upgrades, advanced metering, Direct Load Control (DLC) technologies, disposal fees, etc.

New York Independent System Operator (NYISO) Programs

The New York State Independent System Operator (NYISO) has three load management programs that provide opportunities for every electric customer. Each utility or energy service provider in the State can help you get paid for curtailing your electric load during electric grid high-demand periods. These programs offer differing terms and payments, and are open to all types of customers.

Emergency Demand Response Program

Emergency Demand Response Program (EDRP) pays retail electricity customers to reduce load during specific times when electric service in New York State could be jeopardized. During these “declared events,” participants are expected, though not obligated, to either reduce electricity consumption and/or transfer load to an onsite generator for a minimum of four hours. During these emergency program events, performance is based on how much metered load is reduced. Performance during emergency program events is measured on an hourly basis and payment is computed on the higher of either $500/MWH, or the wholesale electricity price in the customer’s area, during the time of the event. Exact payment arrangements differ by program provider.

Day-Ahead Demand Response Program

Day-Ahead Demand Response Program (DADRP), offers retail electricity customers a chance to bid load reduction capability in New York State’s wholesale electricity market. To participate, companies bid their load reduction capability, on a day-ahead basis, into the wholesale electricity market, where these load reduction bids compete with generators’ offers to meet the State’s electricity demands. If the load reduction bid is a less expensive alternative than a generator’s offer, it is accepted and the bidder is scheduled to reduce load during the hours specified the following day. Customer performance during scheduled load reductions is calculated on an hourly basis, at the wholesale price for electricity in the day-ahead market, during those hours scheduled. Participants may specify a minimum payment, called the curtailment initiation cost, as a condition for being scheduled for one or more hours in a specified block of consecutive hours. Generally, in such cases, the full block is scheduled and the participant receives the higher of the curtailment initiation cost or the hourly location-based marginal prices times the scheduled load.

Installed Capacity-Special Case Resources

Installed Capacity-Special Case Resources program pays retail electricity customers to provide their load reduction capability for a specified contract period. Program participants receive payments for an agreement to curtail usage during times when the electric grid could be jeopardized. Based upon system condition forecasts, participants are notified to curtail this subscribed "capacity," either through the use of on-site generation and/or reducing electricity consumption to a firm power level. Any under-performance results in an assessment of a penalty. To register for the program, participants commit to a load reduction of a minimum of 100 kW with 100 kW increments, subject to a one-hour verification either through an actual event or test to be called by NYISO. When initially registering for ICAP SCR, program providers calculate an unforced capacity obligation (UCAP) that is based upon a participant's claimed load reduction capability, line losses, and historical program performance, if any exists. The UCAP is then sold into wholesale capacity markets where payment rates vary according to a participant's location in the State and the contract period.

Summer 2003 Experience

A variety of customers, large and small, from many sectors, took part in these valuable programs last summer. Although most pledged 1,000 kW or less, several reduced their electricity consumption by over 40,000 kW on just 2-hours notice. Steel foundries, cement factories, and paper mills found these programs worthwhile. But even more diverse sectors, like cheese producers, wineries, scrap yards, and apartment buildings reduced their electricity consumption during certain periods, and were paid for doing so. These commitments helped to avoid jeopardizing the State's electric grid stability. Participants understood just how important their participation was: "The program helps to keep prices reasonable during high electric demand," said one satisfied participant. Another noted: "We are aware of the critical situation that could develop...without programs such as these." They saw the inherent value in developing good energy management habits.

Overview of Demand Response Enabling Technologies

There is a wide variety of technologies that can be effectively targeted to reduce demand (kW) levels, some of which are strictly focused on kW reduction, others of which are also equally effective or predominantly used for energy savings. These can be categorized as follows:

❑ Energy Efficiency Technologies	❑ Energy Management System Load Control
❑ Information and Reporting Systems	❑ Smart Load Control Systems
❑ Direct Load Control	❑ Lighting Technology and Control Options
❑ Backup and Distributed Generation	❑ Load Shifting Technologies

Energy Efficiency Technologies

For the Permanent Demand Reduction Effort component of the Program, a wide variety of energy efficiency measures are regularly observed. Recall that the PDRE involves any endeavor that results in a permanent decrease in kW during the peak period. Further, since the kW-based incentives available in the New York City area are quite high ($475/kW), many customers find this program more attractive than NYSERDA's programs that are more focused on energy savings (kWh). Some of the common categories of energy efficiency measures with associated kW reductions include:

- **Lighting Efficiency and Control** – The category includes any improvement in lamps, ballasts, or fixture, or any lighting redesign, that results in a reduced kW. In regards to lighting controls, a kW decrease may not be achieved unless either some percentage of lights are shut during peak periods, or if some diversified percentage of lights can be relied on to be off during the peak period.
- **Chiller and HVAC Plant Upgrades** – There are many chiller plant upgrades that save demand concurrently with energy. Examples includes chiller or unitary HVAC plant upgrades, efficient drives (for pumping and fans systems), and some control system strategies. The increasingly common VFD measures for HVAC system fans and pumps, typically do not reduce demand during peak periods, so these are generally inappropriate for kW reductions.
- **EMS or BAS System Installation** – The primary decision-making factor for installation of energy management systems (EMS, or better termed building automation systems - BAS) is to support improved and simplified operation of building systems. Inherent in BAS capabilities are numerous energy savings strategies. Some of these energy savings strategies have associated demand reductions. Other BAS strategies can facilitate permanently-based or short-term kW reduction.
- **Process and Industrial Measures** – There are a wealth of efficiency measures that are focused on industrial operations. These can address the specific processes found in the facility, or they can address cross-cutting technologies, such as compressed air, process heating and cooling, and drive systems.

Information and Reporting Systems

The past several years have seen a rapid influx of new technologies that provide next day or real time information on facility energy usage characteristics. These systems are sometimes provided to customers by utilities or program administrators to support customer's internal assessment needs. Such systems can also be provided by independent vendors. Customers report that they find the data useful for achieving load reduction and educating senior management. Other key elements of these systems that make them attractive include the ability to access usage data online, thereby enabling remote assessment of consumption. These systems also facilitate aggregation of data for multiple sites or locations within an enterprise, further simplifying energy and demand management. Such systems also can be used with automated phone, fax, pager, or email notification systems that alert facility management when specified usage thresholds are being reached, or when a curtailment call is imminent.

For the NYSERDA programs, installation of such information technologies is not typically incentivized. The Program seeks to award incentives for technologies that that either have inherent demand reductions or that automatically control one or multiple pieces of energy using equipment to reduce demand. The information systems, unless integrated with some type of automated control system, will require manual human intervention to achieve a demand reduction. Thus, they are not normally incentivized.

Direct Load Control

Direct load control technologies have been available in various configurations for many years. Direct load control technologies effect a system demand reduction when some aggregating entity (the utility, the ISO, or an independent aggregator) acts to turn off, modulate, or cycle connected end use systems. This is generally done on some triggering event (say, a curtailment call), but actions may also be taken on a more regular basis to achieve a diversified permanent load reduction.

Traditionally, these systems were used for control of electric domestic hot water (DHW) heaters, particularly those that were leased to customers by the utility. Following direct load control of DHW, the next end uses that were addressed included air conditioners and swimming pool pumps. Direct load control has also been traditionally more common in the residential sector. Recent technology developments and programmatic endeavors have changed the approaches, extent, and targeted sectors for direct load control. The new technologies have enabled direct control of lighting circuits and larger HVAC system components. Thus, the commercial/industrial sector can now be regularly targeted.

A key example of a more recent technological advance is programmable, direct load control thermostats. These systems, which have been deployed both in the residential and commercial sectors, increase the thermostat setpoint during the cooling season (or reduce it for electric heating systems during the heating season) for connected systems in response to a triggering event.

Direct load control approaches have also been implemented directly by multiple facility enterprises in an effort to achieve a reduced aggregate load during peak periods. Such actions can be done with direct load control technologies like those used by larger scale aggregators, or they can be addressed with custom engineered routines implemented in integrated (multiple facility building automated systems).

Back-Up and Distributed Generation Technologies

Emergency back-up power systems, or any type of distributed generation, can play a key role in developing responsive and comprehensive demand response programs. The NYSERDA Program, as mentioned, has a key initiative associated with application of existing emergency generator systems. Several factors must be carefully assessed before using emergency generator systems for load curtailment purposes. These include:

- **Review of Connected Loads** – Peak coincidence and extent of connected loads is critical, and it is certainly key to develop impact estimates based on connected load rather than generator capacity. What is the kW of the connected loads? Are these loads likely to be operational during a curtailment event? Should more loads or alternative loads be connected to the generator for curtailment purposes?

- **Suitability of Switching Systems** – Load control with emergency generators is only suitable of the transfer switches are appropriate for that role. Can the switching mechanisms successfully handle a curtailment that occurs when the facility is still receiving electric power through the grid? Are the automatic transfer switches able to act sufficiently fast to avoid loss of continuity in end use system operations?
- **Environmental Compliance** – Most regions have strict rules regarding application of power generation equipment if used more than a few hours during a power emergency. What type of fuel is being used by the emergency generator system? What are the exhaust emissions, and do they fall below threshold levels for the anticipated hours of use? Can the system be modified or enhanced to meet environmental requirements?
- **Longer Operating Hours** – Most emergency generators are rated for very few annual operating hours, and their reliability may not be assured if hours exceed some minimum level. It is important to review systems recommendations and compare that with anticipated use for kW curtailment purposes.

Energy Management System Load Control

Energy management or building automation systems (EMS or BAS) are frequently developed with some kW-focused algorithms. These may include programmed scheduling (schedules for certain types of systems that limit the overall facility kW), duty cycling (where only a specified number of units of some type can run at a given time, and those operating units are cycled to reduce concurrent demand), and demand limiting (where a specified kW reduction of overall kW usage threshold is defined for control).

Still, it must be pointed out that the real objective of a building automation system is management of connected systems, typically HVAC and lighting. They facilitate operation of complex building end use systems from a central location, and can greatly simplify the day-to-day efforts of facility managers. A benefit of such control systems is improved operation of buildings, with associated energy savings, but in the perspective of most facility managers, energy savings is a secondary benefit to the major objective of ensuring that the building end use systems effectively provide the services for which they were installed.

Demand reduction should probably be characterized as a tertiary (potential) benefit of building automation systems. In fact, many or most building control systems work on a simple rules-based logic, which is contradicted by demand control strategies. Specifically, the fundamental objective according to control system rules is to use the controlled systems (say the HVAC chiller or pumps) to achieve a certain facility goal (say a specified internal temperature). The routines for demand control frequently add a demand-based rule that may be in contrast to the facility end use service goals. While some systems effectively handle contrasting rules, others are weak in this area. Care must be taken in deciding whether an existing BAS or control system is really suitable for managing concurrent demand reduction objectives.

Smart, Demand-Focused kW Load Control Systems

In recent years, there have been a series of new control developments that has led to some focused demand reduction control systems. Typically, these are dedicated demand management systems that work independently of a BAS, and do not have standard BAS or EMS functionality. Some BAS vendors, however, have been developing enhanced systems that incorporate some of this newer functionality.

The smart demand-focused systems continually monitor facility kW (taking pulses from the primary electrical meter(s), and are also continually developing trending projections that predict the kW level for each successive demand billing period (usually 15 to 30 minute period). The projected period kW in then continually compared to a permanent kW threshold level for the facility. As the demand period progresses, projections that indicate a potential threshold overrun are addressed by employing a smart duty cycling routine that is used to modulate or turn off end use equipment to avoid exceeding the threshold. Controlled equipment, the duration of its potential control, and frequency of control for each connected system are part of the setup for the demand system.

These systems, with sufficient loads connected, are highly effective at achieving significant demand reductions without significant or even noticeable changes in facility comfort. In effect, they effectively level out load irregularities and flatten out the loads over short or long term periods. It is noted, however, that these systems can compromise facility comfort or services if they are used improperly or if demand reduction targets are excessive.

Neural Net Building Control Technologies

Neural net control technologies are smart systems that function as very high end overall building automation systems. They are effectively, a smart building automation system that progressively learns best operation of building systems. Neural net (adaptive learning) computational methodologies are basically the latest generation of artificial intelligence programming systems. Operationally, these systems are ideally suited for full BAS operation, and can readily replace all of a comprehensive BAS' functionality. With their advanced logic, they are readily adaptable for multiple and conflicting rules with different priorities. Thus, they should be excellent for managing demand, while concurrently ensuring successful building system operations.

Neural net vendors, however, have faced some serious marketing challenges, which have resulted in very low penetration of their systems. Specifically, the neural net system's control functionality can seem like a black box to many facility managers, who have consequently been slow to adopt this technology. Essentially, once provided with a set of rules for building end use system operation, the control system works independently, without much human intervention. Further, it can take an extended period for the control software to optimize operation, as it learns from cause and effect from numerous building system and environmental input and output variables. In such system's relatively few installations, they have proven successful operation potential, but they will need rapidly increasing sales to remain a viable, marketable technology.

Lighting Control Technologies

There has been much innovation in the lighting system and control technologies market, all of which can represent a key component of reducing demand in building systems. Standard lighting system energy efficiency and controls have been discussed at length in numerous treatises. But several new technology advances can help provide enhanced demand reduction potential focused at the lighting end use. These include:

- **Scheduling and Demand Control with Lighting Control Panels** – Direct digital lighting control panels are essentially building automation or energy management systems focused on lighting, whereas the general building automation control system is focused at HVAC. When associated with appropriate end use lighting systems, such controls can offer algorithms for enhanced system scheduling, implementation of dimming routines, duty cycling of lighting systems, and demand limiting.
- **Direct Addressable Lighting Systems** – There are now new protocols for directly addressing individual lighting systems or ballasts, and for providing focused control of appropriate units. This can facilitate greatly enhanced levels of occupancy-based or scheduled control of lighting systems, with associated (diversified) kW reductions. These technologies can provide unique opportunities for multiple lighting system level control, continuous dimming, or focused load-shedding ballasts.
- **Power Reducing or Current Limiting Devices** – While power limiting devices for lighting systems have been on the market for many years, they have continually been the subject of much controversy because of high lighting level reductions relative to power input decreases, and due to their adverse impacts of lamp and ballast life. A new generation of power and current limiting devices is now emerging, with initial indications of improved functionality. Many end users and other market actors will remain cautious, however, until these technologies truly prove themselves.

Load Shifting and Fuel Switching Technologies

There are a wide variety of technologies that can fall under consideration in the broad area of kW demand reduction through load shifting or conversion of end use systems to non-electric fuels. While this is clearly too broad a subject, some of the technologies we observe through the NYSERDA program includes:

- **Load Shifting**
  - Thermal Storage
  - Off-Peak Operations for Industrial Facilities
- **Fuel Switching Technologies**
  - Absorption Chillers
  - Steam Turbine Chillers
  - Engine-Driven Chillers
  - Engine-Driven Compressors

Case Studies for the NYSERDA Peak Load Reduction Program

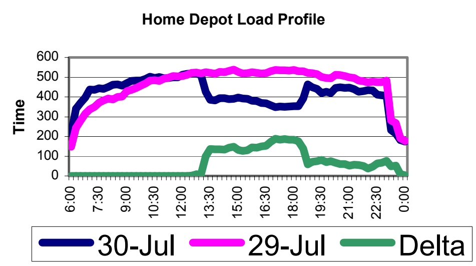
The following sections outline significant projects that serve as case studies of unique demand response enabling technologies. These projects have all been highly successful, cost effective projects, where projected demand impacts prior to project implementation have effectively been achieved.

Case Study One: Home Depot Direct Load Control

Home Depot became involved in demand response because they saw it as a way to contribute to the community by assisting in maintaining reliability of the electric grid system. When a curtailment event is called by the NYISO, Home Depot posts a sign explaining that the dim lighting is a result of them reducing use for the good of the community. This community outreach, combined with the opportunity for NYSERDA to offset the cost of advanced controls, and NYISO revenue made the case for demand response.

Like many other chain stores, Home Depot has a desire to make each store as uniform as possible to minimize costs. Energy is no exception. Previously, the corporate energy manager had no control of the stores energy management systems, causing inconsistent operation, resulting in inefficiencies in energy use across their stores. It is important to remember that while Home Depot has an energy team, there is no energy expert at each store. This creates the need for remote control of each store to enable demand response, efficiency, and cost savings.

Home Depot implemented a sophisticated direct load control system. They started by installing interval meters at each location. In addition to verifying curtailments to the NYISO, interval meters also provide valuable time sensitive usage data that can be used to better operate buildings. Next, a Novar energy management system was installed. This allowed for two-way communications, sending metered data back to corporate and accepting communications from corporate. Home Depot allowed communication through their Local Area Network (LAN). They could now receive data from, and send commands to each store's energy management system. Next, they programmed a command to shut off every other overhead light and all display lighting. These measures resulted in a load reduction of about 130 kW per store.

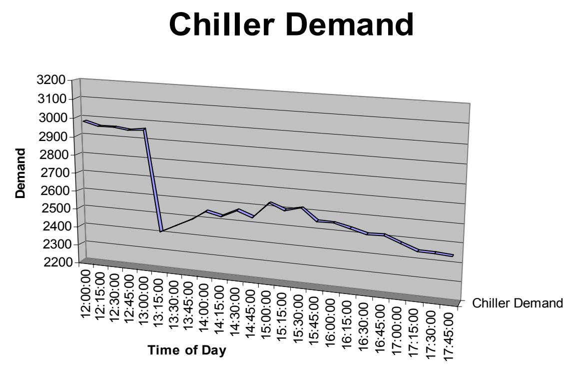


To date, 36 stores have been enabled and remaining stores are currently being enabled. This has positioned Home Depot to reliably reduce New York's peak demand by approximately 4.7 MW when called on by the NYISO's Emergency Demand Response Program. The above graph illustrates the performance of a single Home Depot store on July 30, 2002 when an emergency event was called by the NYISO. The effectiveness of direct load control is highlighted by the fact that the corporate energy manager was not working on this day. He received notification of the NYISO event at home and was able to curtail load at each store from a laptop computer in his living room. NYSERDA provided incentives of approximately $250,000 (for this store location) to offset the capital cost of the equipment, and additional performance revenue was earned from the NYISO.

Case Study Two: Rockefeller Center

Rockefeller Center is a 1.8 million square foot office building in Manhattan. They were committed to curtailing load, but maintaining tenant comfort was a high priority. To do this, Rockefeller Center identified a conservative, reliable curtailment strategy of raising chilled water temperature, lowering the HVAC fan speeds and cycling the elevators and escalators. Given the scale of the cooling system, these measures yielded significant savings. To reliably carry out this plan, Rockefeller Center needed advanced controls and interval metering. Given that the curtailment program they chose contained non-performance penalties, real time metering was a must.

Rockefeller Center began by installing additional metering and control points to include the equipment to be curtailed. This allows them to continuously monitor the operation and demand of each piece of equipment involved. Next, they installed a real time interval meter at the building level. In addition to allowing them to report demand reductions to the NYISO, this provides real time feedback on how the building is performing relative to their commitment. They can constantly monitor demand reduction, and if necessary, they can implement a more aggressive curtailment strategy to avoid penalties and maximize NYISO revenue.

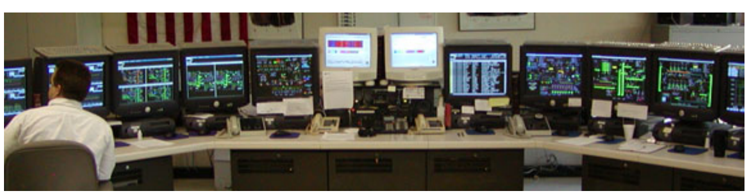


These technologies served them well, allowing them to exceed their committed curtailment of 500 kW, often by a large margin in both 2002 and 2003. Below is an illustration of Rockefellers chilled water demand during a curtailment event.

Case Study Three: Lafarge Building Materials

Lafarge is a 33 MW cement processing plant in upstate New York. Processing raw materials into cement is extremely energy intensive, requiring the crushing and drying of rocks. Lafarge has a large facility, consisting of many separate pieces of equipment, previously with no central control. With NYSERDA's support, Lafarge laid 26 miles of fiber optic Ethernet cable. This line tied 65 electric loads throughout the plant back to a central energy management system. This equipment can now be closely monitored and controlled from a central location. The EMS is also tied into the Internet to provide real time electric pricing information. This allows them to control production based on the price of electricity.

Lafarge has 22 MW of discretionary load that can be shed based on a request from the NYISO. During a grid emergency, Lafarge shuts down their rock crushers. Production can go uninterrupted for a short time by using stockpiled rock that has already been crushed. The energy management system can calculate the load curtailment according to the NYISO standards and provide valuable performance feedback to Lafarge. With software upgrades installed as part of the project, calculated data can now be submitted to the NYISO for payment, with no manual calculations.



Lafarge has also utilized this system to benefit from the volatility of the day-ahead price through the NYISO's Day Ahead Demand Response Program. If prices in the day-ahead market become high enough, Lafarge schedules maintenance on their equipment during the high price period, and sells the energy that they did not use into the market. NYSERDA provided approximately $200,000, which offset the technology cost by 75%. Since installing the system, Lafarge has been able to better manage their equipment on a consistent basis and respond to curtailment requests from the NYISO, resulting in additional demand response revenue of approximately $2 million.

Case Study Four: Ice Storage Tanks at Durst Organization Facility

The Durst Organization, looking for ways to reduce demand in a New York City high-rise office building discovered that they could utilize ice storage to shift cooling load to off peak periods. New York City is a load pocket area, largely due to an inability to import a significant amount of electricity from neighboring areas. This results in high prices, especially during peak times, motivating businesses to investigate demand reduction opportunities. Ice storage is ideal for peak demand reduction, because it shifts usage during the high priced cooling season, without any compromise to building operations.

Ice slurry is created at night by the chillers and stored in the insulated tanks. A refrigerant is then circulated between the ice slurry in the tanks and the cooling coils to provide cooling during the daytime. The organization installed 28 ice storage tanks, which were able to provide 4,000 ton-hours of cooling. This allows them to run an 800-ton electric chiller at night and let it sit idle during the day. The ice storage tanks, in conjunction with the installation of more efficient chillers resulted in a demand reduction of over 600 kW. NYSERDA provided nearly $300,000 in incentives to help offset the capital cost.

Conclusions

In this paper we have described the NYSERDA and NYISO programs, discussed some key demand-response enabling technologies, and illustrated some applications of some of these technologies in the programs. Both the described programs and the technology market are evolving rapidly. It is clear that there will continue to be dramatic evolution in these endeavors in the coming years.

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